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OFF-SITE ENVIRONMENTAL MONITORING REPORT
Radiation Monitoring Around United States Nuclear Test Areas, Calendar Year 1985

compiled by

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PREFACE

The U.S. Atomic Energy Commission (AEC) used the Nevada Test Site (NTS) from January 1951 through January 19, 1975, for conducting nuclear weapons tests, nuclear rocket-engine development, nuclear medicine studies, and other nuclear and non-nuclear experiments. Beginning January 19, 1975, these activities became the responsibility of the newly formed U.S. Energy Research and Development Administration (ERDA). On October 1, 1977 the ERDA was merged with other energy-related agencies to form the U.S. Department of Energy (DOE). Atmospheric nuclear tests were conducted periodically from January 27, 1951, through October 30, 1958, after which a testing moratorium was in effect until September 1, 1961. Since September 1, 1961, all nuclear detonations have been conducted underground with the expectation of containment, except for four slightly above-ground or shallow underground tests of Operation Dominic II in 1962 and five nuclear earth-cratering experiments conducted under the Plowshare program between 1962 and 1968.

Prior to 1954, an off-site surveillance program was performed by the Los Alamos Scientific Laboratory and the U.S. Army. From 1954 through 1970 the U.S. Public Health Service (PHS), and from 1970 to the present the U.S. Environmental Protection Agency (EPA) have provided an Off-Site Radiological Safety Program under an Interagency Agreement. The PHS or EPA has also provided off-site surveillance for U.S. nuclear explosive tests at places other than the NTS.

Since 1954, an objective of this surveillance program has been to measure levels and trends of radioactivity, if present, in the environment surrounding testing areas to ascertain whether the testing is in compliance with existing radiation protection standards. Off-site levels of radiation and radioactivity are assessed by sampling milk, water, and air; by deploying dosimeters; and by sampling food crops, soil, etc., as required. Personnel with mobile monitoring equipment are placed in areas downwind from the test site prior to each test in order to implement protective actions, provide immediate radiation monitoring, and obtain environmental samples rapidly after any release of radioactivity. Since 1962, aircraft have also been deployed to rapidly monitor and sample releases of radioactivity during nuclear tests. Monitoring data obtained by the aircraft crew immediately after a test are used to position mobile radiation monitoring personnel on the ground. Data from airborne sampling are used to quantify the amounts, diffusion, and transport of the radionuclides released.

Beginning with Operation Upshot-Knothole in 1953, a report was published by the PHS summarizing the surveillance data for each test series. In 1959 for reactor tests, and in 1962 for weapons and Plowshare tests, such data were published for those tests that released radioactivity detectable off the NTS.

The reporting interval was changed again in 1964 to semi-annual publication of data for each 6-month period which also included the data from the individual reports.

In 1971, the AEC implemented a requirement, now incorporated into DOE Order 5484.1, that each contractor or agency involved in major nuclear activities provide a comprehensive annual radiological monitoring report. This is the fourteenth annual report in this series; it summarizes the off-site activities of the EPA during CY 1985.

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ABBREVIATIONS, SYMBOLS AND CONVERSIONS

ASN	Air Surveillance Network
Bq	Becquerel, one disintegration per second
CG	Concentration Guide
Ci	Curie
CP-1	Control Point One
CY	Calendar Year
d	day
DOE	U.S. Department of Energy
DOE/NV	Department of Energy, Nevada Operations Office
EMSL-LV	Environmental Monitoring Systems Laboratory, Las Vegas
EPA	U.S. Environmental Protection Agency
eV	electron volt
g	gram
Gy	Gray, equivalent to 100 rad (1 J/kg)
GZ	Ground Zero
h	hour
HTO	tritiated water
L	liter
LTHMP	Long-Term Hydrological Monitoring Program
m	meter
MDC	Minimum Detectable Concentration
MSL	Mean Sea Level
MSN	Milk Surveillance Network
NGTSN	Noble Gas and Tritium Surveillance Network
NTS	Nevada Test Site
Pa	Pascal - unit of pressure
R	Roentgen
rad	unit of absorbed dose, 100 ergs/g
rem	the rad adjusted for biological effect
Sv	Sievert, equivalent to 100 rem
TLD	thermoluminescent dosimeter

PREFIXES

a	atto	$= 10^{-18}$
f	femto	$= 10^{-15}$
p	pico	$= 10^{-12}$
n	nano	$= 10^{-9}$
μ	micro	$= 10^{-6}$
m	milli	$= 10^{-3}$
k	kilo	$= 10^{3}$
M	Mega	$= 10^{6}$

CONVERSIONS

Multiply	By	To Obtain
Concentration Guides		
μCi/mL	10^{9}	pCi/L
μCi/mL	10^{12}	pCi/m^3
SI Units		
rad	10^{-2}	Gray (Gy = 1 Joule/kg)
rem	10^{-2}	Sievert (Sv)
pCi	0.037	Becquerel

SECTION 1

INTRODUCTION

The EMSL-LV operates an Off-Site Radiological Safety Program around the NTS and other sites as requested by the Department of Energy (DOE) under an Interagency Agreement between DOE and EPA. This report, prepared in accordance with DOE guidelines (DOE85a), covers the program activities for calendar year 1985. It contains descriptions of pertinent features of the NTS and its environs, summaries of the EMSL-LV dosimetry and sampling methods, analytical procedures, quality assurance, and the analytical results from environmental measurements. Where applicable, dosimetry and sampling data are compared to appropriate guides for external and internal exposures of humans to ionizing radiation.

SECTION 2

SUMMARY

PURPOSE

It is U.S. Environmental Protection Agency (EPA) policy to protect the general public and the environment from pollution caused by human activities. This includes radioactive contamination of the biosphere and concomitant radiation exposure of the population. To this end and in concordance with U.S. Department of Energy (DOE) policy of keeping radiation exposure of the general public as low as reasonably achievable, the EPA's Environmental Monitoring Systems Laboratory in Las Vegas (EMSL-LV) conducts an Off-Site Radiological Safety Program centered on the DOE's Nevada Test Site. This program is conducted under an Interagency Agreement between EPA and DOE.

The principal activities of the Off-Site Radiological Safety Program are: routine environmental monitoring for radioactive materials in various media and for radiation in areas which may be affected by nuclear tests; and protective actions in support of the nuclear testing program. These are conducted to document compliance with standards, to identify trends, and to provide information to the public. This report summarizes these activities for CY 1985.

Locations

Most of the radiological safety effort is applied in the areas around the Nevada Test Site (NTS) in south-central Nevada. The principal activity at the NTS is testing of nuclear devices, though other related projects are also conducted. This portion of Nevada is sparsely settled, 0.5 person/km^2, and has a continental arid climate. The largest town in the near off-site area is Beatty, located about 65 km west of the NTS with a population of about 900.

Underground tests have been conducted in several other States for various purposes. At these sites in Alaska, Colorado, New Mexico, and Mississippi, a long-term hydrological monitoring program is conducted to detect any possible contamination of potable water and aquifers near these sites.

Special Test Support

During CY85, personnel were deployed in support of the 16 announced nuclear tests at the NTS. Only once was radioactivity detected off site. This was during the planned ventilation of a tunnel following the Misty Rain test. Xenon-133 was detected at an unpopulated location in a concentration which at most would have led to a dose of 6×10^{-4} mrem (6×10^{-6}) mSv); only 10% of that dose would have been received by a resident at Rachel, NV.

Pathways Monitoring

The pathways leading to human exposure to radionuclides, namely air, water, and food, are monitored by networks of sampling stations. The networks are designed not only to detect radiation from DOE/NV nuclear test areas but also to detect increases in population exposure from other sources.

In 1985 the air surveillance network (ASN) consisted of 30 continuously operating stations surrounding the NTS and 77 standby stations (operated 1 or 2 weeks each quarter) in all States west of the Mississippi River. Other than naturally occurring beryllium-7, the only activity detected by this network was plutonium-239 from worldwide fallout.

The noble gas and tritium sampling network (NGTSN) consisted of 17 stations off site (off the NTS and exclusion areas) in 1985. No NTS-related radioactivity was detected at any off-site station by this network. Tritium concentrations in air remained below MDC levels and krypton-85 concentration continued the upward trend which started in 1960, reflecting the worldwide increase in the use of nuclear technology.

The long-term hydrological monitoring of wells and surface waters near sites of nuclear tests showed only background tritium and other radionuclide concentrations except for those wells that had detectable activity in previous years or those that had been spiked with radionuclides for hydrological tests.

The milk surveillance network consisted of 28 sampling locations within 300 km of the NTS and about 122 standby locations in the Western U.S. The tritium concentration in milk was at background levels, and strontium-90 from worldwide fallout continued the slow downward trend observed in recent years.

Other foods analyzed have been mainly meat from domestic or game animals and garden vegetables. The radionuclide most frequently found in the edible portion of the sampled animals is cesium-137. However, its concentration has been near the MDC since 1968. Strontium-90 in samples of animal bone remain at very low levels as does plutonium-239 in both bone and liver samples.

External Exposure

External exposure is monitored by a network of TLD's at 129 locations surrounding the NTS and by TLD's worn by 53 off-site residents. In a few cases, small exposures of a few mR above the average for the person were measured. Except for several occupational exposures, all such net exposures were very low and were not related to NTS activities. The range of exposures measured, varying with altitude and soil constituents, is similar to the range of such exposures found in other areas of the U.S.

Internal Exposure

Internal exposure is assessed by whole-body counting supplemented by phoswich detectors to measure lung burdens of radioactivity. In 1985, counts were made on 106 off-site residents, as well as on 260 other individuals for occupational or other reasons. Natural potassium-40 was found as expected, but no nuclear test related radioactivity was detected. In addition, physical examinations of the off-site residents revealed a normally healthy population consonant with the age and sex distribution of that population.

Community Monitoring Stations

The 15 Community Monitoring Stations became operational in 1982. Each station is operated by a resident of the community who is trained to collect samples and interpret some of the data. Each station is an integral part of the ASN, NGTSN and TLD networks and is also equipped with a pressurized ion chamber system and recording barograph. Samples and data from the stations are analyzed by EMSL-LV and are also interpreted and reported by the Desert Research Institute, University of Nevada. Data from these stations are reported herein as part of the networks in which they participate.

Dose Assessment

Doses were calculated for an average adult living in Nevada based on the Kr-85, Sr-90, HTO and Pu-239 detected by the monitoring networks. Using conservative assumptions, the estimated dose would have been about 0.14 mrem/yr (1.4 μSv/yr), a small fraction of the variation of 10 mrem/yr due to the natural radionuclide content of the body. The only NTS-related radioactivity detected during 1985 was xenon-133 picked up on a noble gas sampler placed at Rachel during the tunnel ventilation following the Misty Rain test. The concentration of 11 pCi/m^3 for the 24-hour sample was not detectable on the normal noble gas sampler. This concentration would have caused a dose of 0.06 μrem to a person outdoors for the 24 hours. Otherwise, no radioactivity originating on the NTS was detectable by the monitoring networks so no dose assessment could be made on the reported emissions. However, atmospheric dispersion calculations, based on those emissions, indicate that the highest individual dose would have been 40 nanorem (4×10^{-7}mSv) and the dose to the population with 80 km of CP-1 would have been 2×10^{-4} person-rem (2×10^{-6} person-Sv).

SECTION 3

DESCRIPTION OF THE NEVADA TEST SITE

Historically, the major programs conducted at the NTS have been nuclear weapons development, proof-testing and weapons safety and effects, testing peaceful uses of nuclear explosives (Plowshare Program), reactor engine development for nuclear rocket and ramjet applications (Projects Rover and Pluto), high-energy nuclear physics research, seismic studies (Vela Uniform), and studies of high-level waste storage. During 1985, nuclear weapons development, proof-testing and weapons safety, nuclear physics programs, and studies of high-level waste storage were continued at the NTS. Project Pluto was discontinued in 1964; Project Rover was terminated in January 1973; Plowshare tests were terminated in 1970; Vela Uniform studies ceased in 1973. All nuclear weapons tests since 1962 have been conducted underground. More detail and pertinent maps for the portions of this section are included in Appendix A. Only selected information is presented in this Section.

SITE LOCATION

The NTS is located in Nye County, Nevada, with its southeast corner about 90 km northwest of Las Vegas (Figure 1). It has an area of about 3,500 square km and varies from 40 to 56 km in width (east-west) and from 64 to 88 km in length (north-south). This area consists of large basins or flats about 900 to 1,200 m above mean sea level (MSL) surrounded by mountain ranges rising 1,800 to 2,300 m above MSL.

The NTS is surrounded on three sides by exclusion areas, collectively named the Nellis Air Force Range, which provide a buffer zone between the test areas and public lands. This buffer zone varies from 24 to 104 km between the test area and land that is open to the public. Depending upon wind speed and direction at the time of testing, from 2 to more than 6 hours will elapse before any release of airborne radioactivity could pass over public lands.

CLIMATE

The climate of the NTS and surrounding area is variable, due to its variations in altitude and its rugged terrain. Generally, the climate is referred to as continental arid. Throughout the year, there is insufficient precipitation to support the growth of common food crops without irrigation.

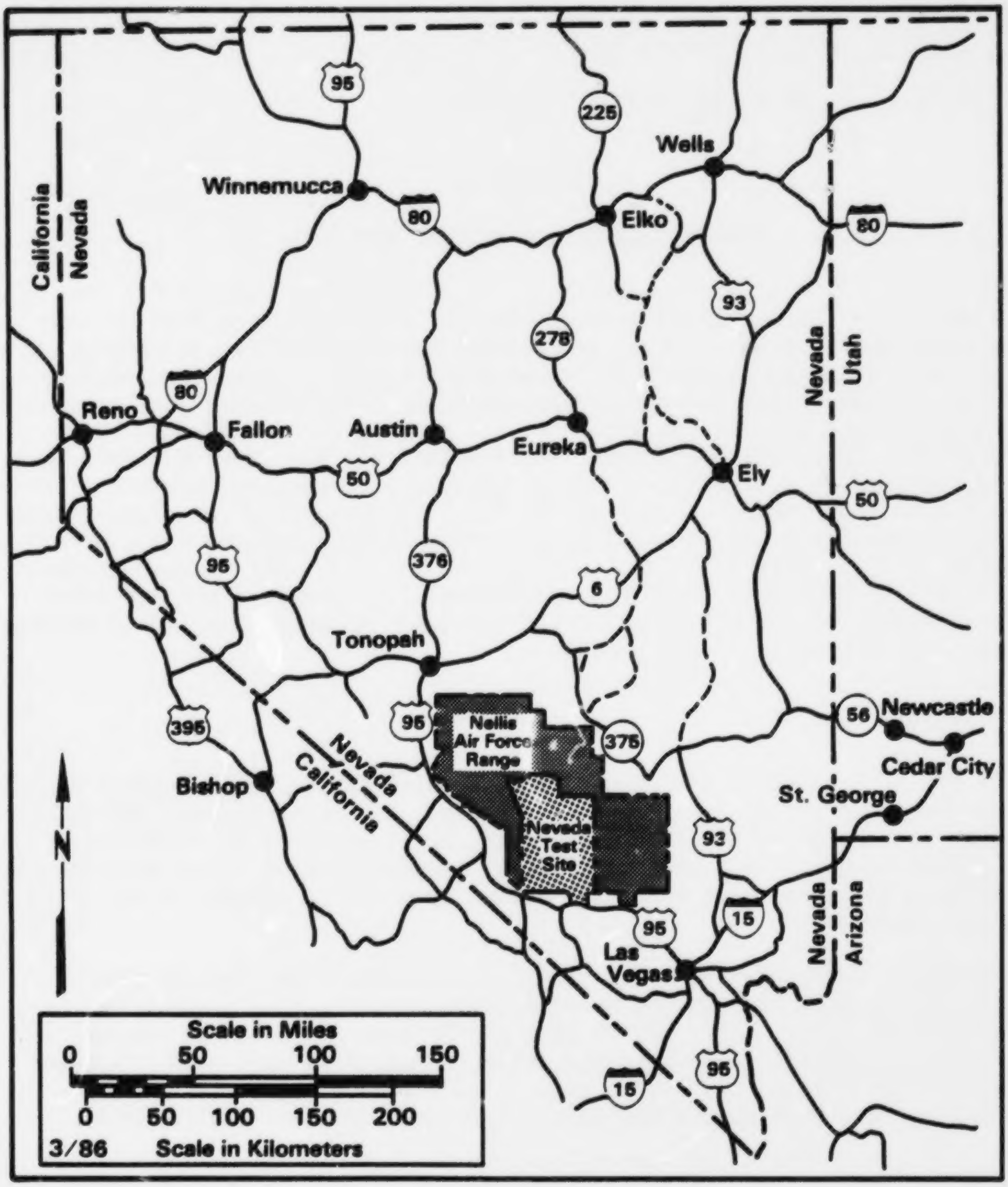

California
Nevada
Winnemucca
Wells
Elko
Reno
Fallon
Austin
Eureka
Ely
Tonopah
Nellis Air Force Range
Nevada Test Site
Bishop
Newcastle
Cedar City
St. George
Las Vegas
Nevada
Utah
Nevada
Arizona
Nevada
California
95
225
80
80
93
278
80
50
50
95
376
6
395
95
375
56
93
15
95
95
15
N
Scale in Miles
0
50
100
150
0
50
100
150
200
3/86
Scale in Kilometers

Figure 1. Location of the Nevada Test Site (NTS).

As Houghton et al. (Ho75) point out, 90 percent of Nevada's population lives in areas with less than 25 cm of rainfall per year or in areas that would be classified as mid-latitude steppe to low-latitude desert regions.

The wind direction, as measured on a 30 m tower at an observation station about 9 km NNW of Yucca Lake near CP-1, is predominantly northerly except during May through August when winds from the south-southwest predominate (Qu68). Because of the prevalent mountain/valley winds in the basins, south to southwest winds predominate during daylight hours of most months. During the winter months southerly winds have only a slight edge over northerly winds for a few hours during the warmest part of the day. These wind patterns are often quite different at other locations on the NTS because of local terrain effects and differences in elevation.

GEOLOGY AND HYDROLOGY

Geological and hydrological studies of the NTS have been in progress by the U.S. Geological Survey and various other organizations since 1956. Because of this continuing effort, the surface and underground geological and hydrological characteristics for much of the NTS are known in considerable detail (see Figure A-1). This is particularly true for those areas in which underground experiments are conducted. A comprehensive summary of the geology and hydrology of the NTS was published in 1975 (Wi75).

The aquifers underlying the NTS vary in depths from about 200 m beneath the surface of valleys in the southeastern part of the site to more than 500 m beneath the surface of highlands to the north. Although much of the valley fill is saturated, downward movement of water is retarded by various tuffs and is extremely slow. The primary aquifer in these formations consists of Paleozoic carbonates that underlie the more recent tuffs and alluviums.

LAND USE OF NTS ENVIRONS

Industry within the immediate off-NTS area includes approximately 40 active mines and mills, oil fields in the Railroad Valley area, and several industrial plants in Henderson, Nevada. The number of employees for these operations may vary from one person at several of the small mines to several hundred workers for the oil fields north of the NTS and the industrial plants in Henderson. Most of the individual mining operations involve less than 10 workers per mine; however, a few operations employ 100 to 250 workers.

The major body of water close to the NTS is Lake Mead (120 km southeast, Figure A-2), a manmade lake supplied by water from the Colorado River. Lake Mead supplies about 60 percent of the water used for domestic, recreational, and industrial purposes in the Las Vegas Valley. Some Lake Mead water is used in Arizona, southern California, and Mexico. Smaller reservoirs and lakes located in the area are used primarily for irrigation, for watering livestock, and for wildlife refuges.

Dairy farming is not extensive within 300 km of the NTS. As shown in Figures A-4 and A-5 the family cows and goats are distributed in all directions around the NTS, whereas most dairy cows are located to the southeast (along the Muddy and Virgin River valleys and in Las Vegas, Nevada), northeast (Lund), and southwest (near Barstow, California).

Grazing is the most common land use within 300 km of the site. Approximately 500,000 cattle and 150,000 sheep are distributed within the area as shown in Figures A-6 and A-7, respectively. The estimates are based on information supplied by the California Crop and Livestock reporting service (CA85), from 1985 agricultural statistics supplied by the Nevada Department of Agriculture (NV86) and 1985 estimates based on 1982 census information supplied by the Utah Department of Agriculture (UT82).

POPULATION DISTRIBUTION

Excluding Clark County, the major population center (approximately 536,000 in 1984), the population density within a 150 km radius of CP-1 on the NTS is about 0.5 persons per square kilometer. For comparison, the 48 contiguous states (1980 census) had a population density of approximately 29 persons per square kilometer. The estimated average population density for all of Nevada in 1980 was 2.8 persons per square kilometer.

The off-site area within 80 km of the NTS (the area in which the dose commitment must be determined for the purpose of this report) is predominantly rural, Figure A-3. Several small communities are located in the area, the largest being in the Pahrump Valley. This growing rural community, with an estimated population of about 5,500, is located about 72 km south of the NTS CP-1. The Amargosa Farm Area, which has a population of about 1,200, is located about 50 km southwest of CP-1. The largest town in the near off-site area is Beatty, which has a population of about 900 and is located approximately 65 km to the west of CP-1.

AIRBORNE RELEASES OF RADIOACTIVITY AT THE NTS DURING 1985

All nuclear detonations during 1985 were conducted underground and were contained, although occasional releases of low-level radioactivity occurred during re-entry drilling, seepage through fissures in the soil or ventilation of tunnel areas. Table 1 shows the total quantities of radionuclides released to the atmosphere, as reported by the DOE Nevada Operations Office (DOE86). Because these releases occurred throughout the year, and because of the distance from the points of releases to the nearest sampling station, in only one instance was radioactive material listed in this table detected off site.

TABLE 1. TOTAL AIRBORNE RADIONUCLIDE EMISSIONS AT THE NTS DURING 1985

Radionuclide	Half-Life (days)	Quantity Released (Ci)
Tritium	4,500	116
Argon-37	35.1	9.0
Krypton-85	3,920	17
Xenon-133	5.24	734.9
Xenon-133m	2.2	8.3
Xenon-135	0.38	28.9
Iodine-131	8.07	0.007
Iodine-133	0.87	0.042
Iodine-135	0.28	0.042

SECTION 4

QUALITY ASSURANCE

GOALS

The goals of the EMSL-LV quality assurance program are to assure the collection and analysis of environmental samples with the highest degree of accuracy and precision obtainable with state-of-the-art instrumentation and to achieve the best possible completeness and comparability given the extent and type of networks from which samples are collected. To meet these goals, it is necessary to devote strict attention to sample collection, sample analysis, and quality assurance procedures.

SAMPLE COLLECTION

The collection of samples is governed by a detailed set of Standard Operating Procedures (SOP's). These SOP's prescribe the frequency and method of collection, the type of collection media, sample containment and transport, sample preservation, sample identification and labeling, and operating parameters for the instrumentation. Sample control is an important segment of these activities as it enables tracking from collection to analysis for each sample and governs the selection of duplicate samples for analysis and the samples chosen for replicate analysis.

These procedures provide assurance that sample collection, labeling and handling are standardized to minimize sample variability due to inconsistency among these variables.

SAMPLE ANALYSIS

All of the networks operated by the EMSL-LV have individual Quality Assurance Project Plans. The procedures required by these plans assure that the results of analysis will be of known quality and will be comparable to results obtained elsewhere with equivalent procedures. These Plans are summarized in the following sections.

External QA

External QA provides the data from which the accuracy of analysis (a combination of bias and precision) can be determined. Bias is assessed from the results obtained on intercomparison study samples and on samples "spiked" with known amounts of radionuclides. The Off-Site Radiological Safety Program participates in Intercomparison Study Programs that include environmental sample analysis, TLD dosimetry, and whole-body counting. Also, samples which are undisclosed to the analyst are spiked by adding known amounts of radionuclides and then entered into the normal chain of analysis.

Data for precision are collected from duplicate and replicate analyses. At least 10 percent of all samples are collected in duplicate. When analyzed, the data indicate the precision of both sample collection and analysis. Replicate counting of at least 10 percent of all samples yield data from which the precision of counting can be determined.

If the bias and precision data are of sufficient quality (i.e., normalized deviation in Table C-3 is less than 3), then comparability, i.e., comparison of the data with those of other analytical laboratories, can be assessed with confidence. The results of external QA procedures are shown in Appendix C.

Internal QA

Internal QA consists of those procedures used by the analyst to assure proper sample preparation and analysis. The principal procedures used are the following:

- Instrument background counts
- Blank and reagent analyses
- Instrument calibration with known nuclides
- Laboratory control standards analysis
- Performance check-source analysis
- Maintenance of control charts for background and check-source data
- Scheduled instrument maintenance

These procedures ensure that the instrumentation is not contaminated, that calibration is correct, and that standards carried through the total analytical procedure are accurately analyzed.

VALIDATION

After the results are produced, supervisory personnel examine the data to determine whether or not the analysis is valid. This includes checking all procedures from sample receipt to analytical result with particular attention to the internal QA data and comparison of the results with previous data from similar samples at the same location.

Any variant result or failure to follow internal QA procedures during sample analysis will trigger an internal audit of the analytical procedures and/or a re-analysis of the sample or its duplicate.

AUDITS

All analytical data are reviewed by personnel of the Dose Assessment Branch for completeness and consistency. Investigations are conducted to resolve any inconsistencies and corrective actions are taken if necessary. SOP's and QA project plans are revised as needed following review of procedures and methodology. The EMSL-LV QA Officer audits the operations periodically.

SECTION 5

RADIOLOGICAL SAFETY ACTIVITIES

The radiological safety activities of the EMSL-LV are divided into two major areas: special test support and routine environmental surveillance which includes pathways monitoring and internal and external exposure monitoring. Both of these activities are designed to detect any increase in environmental radiation which might cause exposure to individuals or population groups so that protective actions may be taken, to the extent feasible. These activities are described in the following portions of this report.

SPECIAL TEST SUPPORT

Before each nuclear test, mobile monitoring personnel are positioned in the off-site areas most likely to be affected should a release of radioactive material occur. They ascertain the locations of residents, work crews and animal herds and obtain information relative to controllability of residents in communities and remote areas. These monitors, equipped with radiation survey instruments, gamma exposure-rate recorders, thermoluminescent dosimeters (TLD's), portable air samplers, and supplies for collecting environmental samples, are prepared to conduct a monitoring program as directed from the NTS Control Point (CP-1) via two-way radio communications.

For those tests which might cause ground motion detectable off site, EPA monitors are stationed at locations where hazardous situations might ensue. At these locations, occupants are notified of potential hazard so they can take precautionary measures.

Professional EPA personnel serve as members of the Test Controller's Advisory Panel to provide advice on possible public and environmental impact of each test and feasible protective actions in case accidental releases of radioactivity should occur.

An EG&G cloud sampling and tracking aircraft is always flown over the NTS to obtain samples, assess total cloud volume, and provide long-range tracking in the event of a release of airborne radioactivity. A second aircraft is also flown to gather meteorological data and to perform cloud tracking. Information from these aircraft can be used in positioning the radiation monitors.

During CY 1985, EMSL personnel were deployed in support of the 16 announced underground tests, none of which accidently released radioactivity which could be detected off site. However, following the Misty Rain event, conducted on April 6, radioactivity was detected in the tunnel leading to the test point although containment measures prevented escape of the radioactivity to the atmosphere. To gain entry to the tunnel and the instrumentation contained therein, the tunnel was ventilated and the escaping gas passed through high efficiency and charcoal filters. To monitor this activity, special compressed gas samplers were placed at six locations off the NTS. The locations were Rachel, Hiko, Tempiute, Medlin's Ranch, Reed Ranch and Lathrop Wells. The sampler at Reed Ranch detected xenon-133 at a concentration of 47 ± 10 pCi/m^3 and at Rachel 11 ± 5 pCi/m^3. If the concentration of 47 pCi/m^3 (1.7 Bq/m^3) had been maintained for the full week of the ventilating period, and someone had been living at that location, the dose would have amounted to 6 x 10^{-4} mrem (6 x 10^{-6} mSv) to the skin or about equivalent to 5 minutes exposure to background at that location. The dose at Rachel is calculated in Section 5. None of the other samplers detected noble gases above the background values. Also, none of the noble gas samplers in the routine sampling network detected any of the radioactive xenon released during this tunnel ventilation.

PATHWAYS MONITORING

The off-site radiation monitoring program includes a pathways monitoring system consisting of air, water and milk surveillance networks surrounding the NTS and a limited animal sampling project. These are explained in detail below.

Air Surveillance Network (ASN)

Network Design--

The ASN monitors an important route of human exposure to radionuclides: inhalation of airborne materials. The concentration and the source must both be determined if appropriate corrective actions are to be taken. The ASN is designed to cover the areas within 350 km of the NTS with some concentration of stations in the prevailing downwind direction (Figure 2). The coverage is constrained to those locations having available electrical power and a resident willing to operate the equipment. This continuously operating network is reinforced by a standby network which covers the contiguous States west of the Mississippi River, (Figure 3).

Methods--

During 1985 the ASN consisted of 30 continuously operating sampling stations and 77 standby stations. The air sampler at each station was equipped to collect both particulate radionuclides and reactive gases.

Samples of airborne particulates were collected at each active station on 5-cm diameter glass-fiber filters at a flow rate of about 81 m^3 per day. Filters were changed after sampler operation periods of 2 or 3 days (160 to 240 m^3). Activated charcoal cartridges placed directly behind the filters to collect gaseous radioiodine were changed at the same time as the filters. The standby network was activated for 1 to 2 weeks per quarter at most locations. The samplers are identical to those used in the ASN and are operated by State and municipal health department personnel or by local residents. All air filters and charcoal cartridges were analyzed by the EMSL-LV.

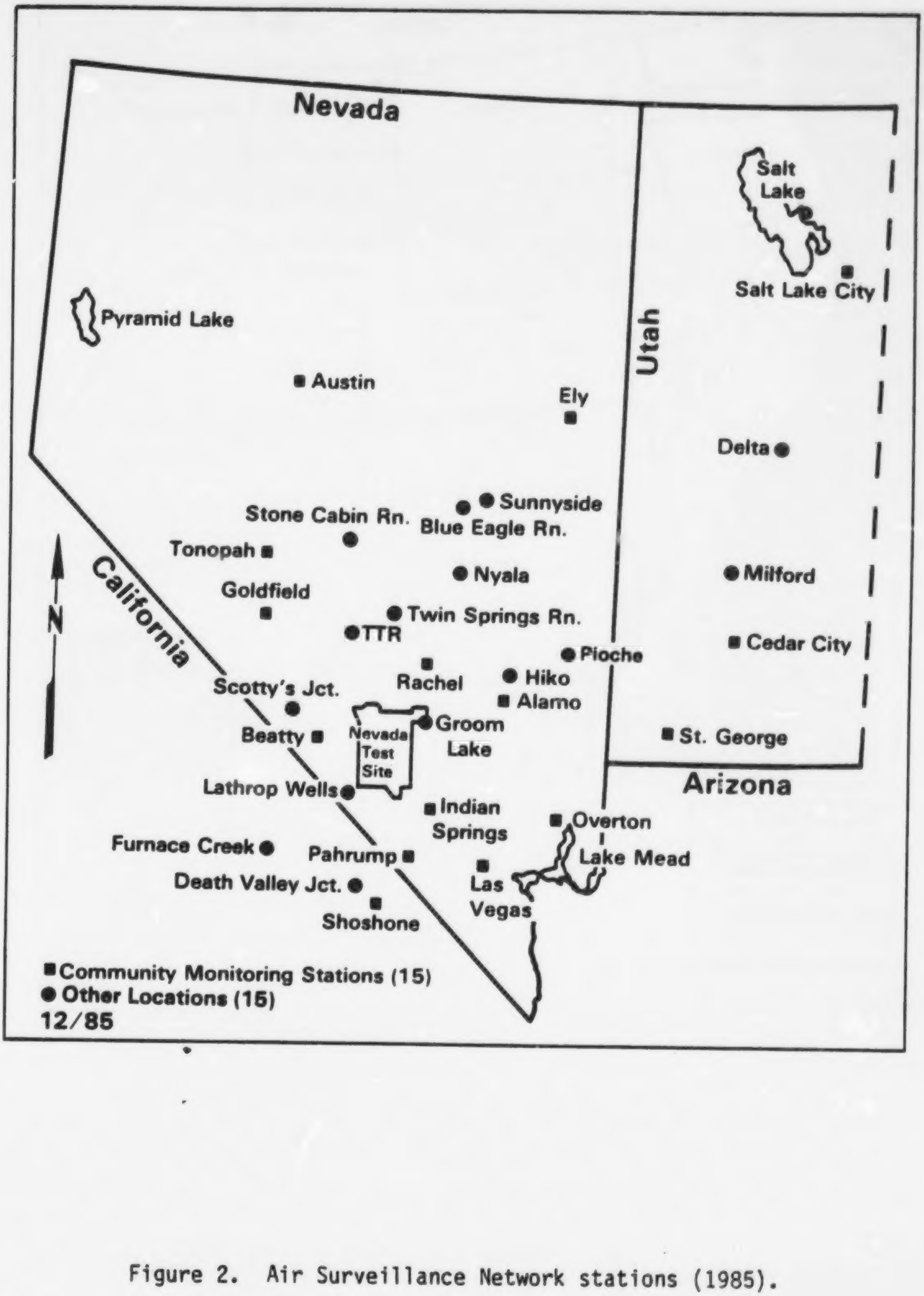

Nevada
Utah
California
Arizona
N
Pyramid Lake
Salt Lake
Salt Lake City
Austin
Ely
Delta
Sunnyside
Stone Cabin Rn.
Blue Eagle Rn.
Tonopah
Nyala
Milford
Goldfield
Twin Springs Rn.
TTR
Pioche
Cedar City
Rachel
Hiko
Alamo
Scotty's Jct.
Groom Lake
Beatty
Nevada Test Site
St. George
Lathrop Wells
Indian Springs
Overton
Lake Mead
Furnace Creek
Pahrump
Death Valley Jct.
Las Vegas
Shoshone
■ Community Monitoring Stations (15)
● Other Locations (15)
12/85

Figure 2. Air Surveillance Network stations (1985).

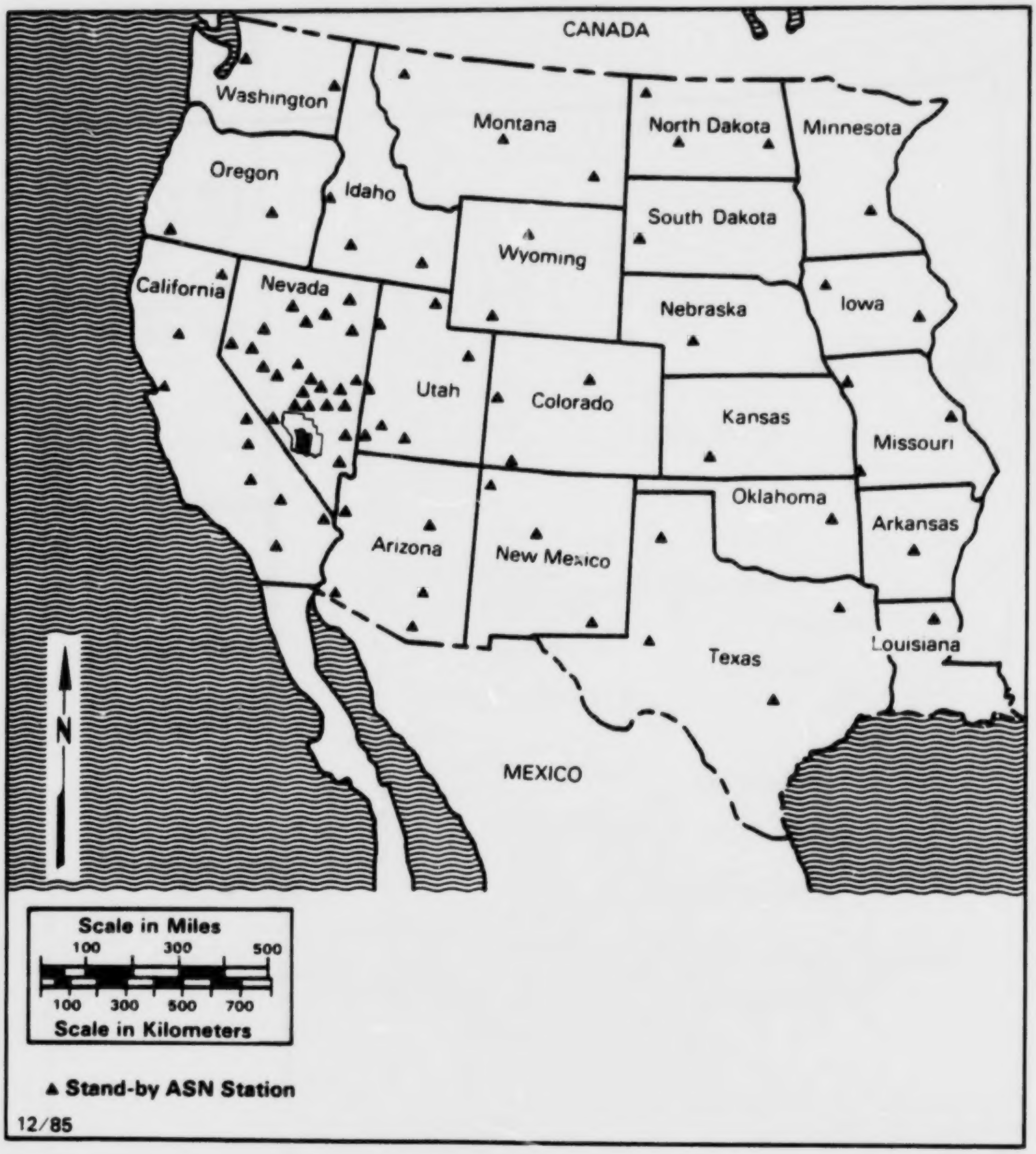

CANADA
Washington
Oregon
Idaho
Montana
North Dakota
Minnesota
South Dakota
Wyoming
California
Nevada
Nebraska
Iowa
Utah
Colorado
Kansas
Missouri
Oklahoma
Arkansas
Arizona
New Mexico
Texas
Louisiana
MEXICO
N
Scale in Miles
100
300
500
100
300
500
700
Scale in Kilometers
▲ Stand-by ASN Station
12/85

Figure 3. Standby Air Surveillance Network stations (1985).

Results--

During 1985, no airborne radioactivity related to nuclear testing at the NTS was detected on any sample from the ASN. Throughout the network, beryllium-7 was the only nuclide detected by gamma spectroscopy. The principal means of beryllium-7 production is from spallation of oxygen-16 and nitrogen-14 in the atmosphere by cosmic rays. Appendix Tables E-1 and E-2, summarize the data from the ASN samples. All time-weighted averages (Avg in the tables) are less than 1 percent of the Concentration Guide (Appendix D) for exposure to the general public, however, these guides do not apply to naturally occurring radionuclides.

Two special studies are performed on the samples from the ASN: a gross beta analysis of the filters from 5 stations, and plutonium-238 and plutonium-239 analysis of composited filters from 15 states. The results from the plutonium-239 analyses are shown in Appendix Table E-4; plutonium-238 results were <MDC.

The gross beta analysis is used to detect trends in atmospheric radioactivity since this analysis is more sensitive than gamma spectrometry. For this study, three stations north and east of the NTS, and two stations south and west of the NTS are used. The three filters per week from each station are analyzed for gross beta activity after a 7-day delay to decrease the contribution from thoron daughter activity. The data suggest little significant difference among stations and indicate a relatively stable concentration compared to previous years (Figure 4). The maximum concentration measured was 0.19 pCi/m^3, the minimum was <0.001 pCi/m^3, and the arithmetic average was 0.016 pCi/m^3 (0.6 mBq/m^3). A summary of the data is shown in Appendix Table E-3.

Noble Gas and Tritium Surveillance Network (NGTSN)

Network Design--

There are several sources for the radionuclides monitored by this network. Noble gases are emitted from nuclear power plants, propulsion reactors, reprocessing facilities and nuclear explosions. Tritium is emitted from the same sources and is also produced naturally. The monitoring network will be affected by all these sources, but must be able to detect NTS emissions. For this purpose some of the samplers are located close to the NTS and particularly in drainage-wind channels leading from the test areas. In 1985 this network consisted of 17 stations as shown in Figure 5.

Methodology--

Samples of air are collected by either of two methods; by directly compressing or by liquefying air using cryogenic techniques. Either type of equipment continuously samples air over a 7-day period and stores approximately 1 m^3 of air in pressure tanks. The tanks are exchanged weekly and returned to the EMSL-LV where their contents are analyzed. Analysis starts by condensing the samples at liquid nitrogen temperature and using gas chromatography to separate the gases. The separate fractions of radioxenon and radiokrypton are dissolved in scintillation cocktails and counted in a liquid scintillation counter (see Appendix B).

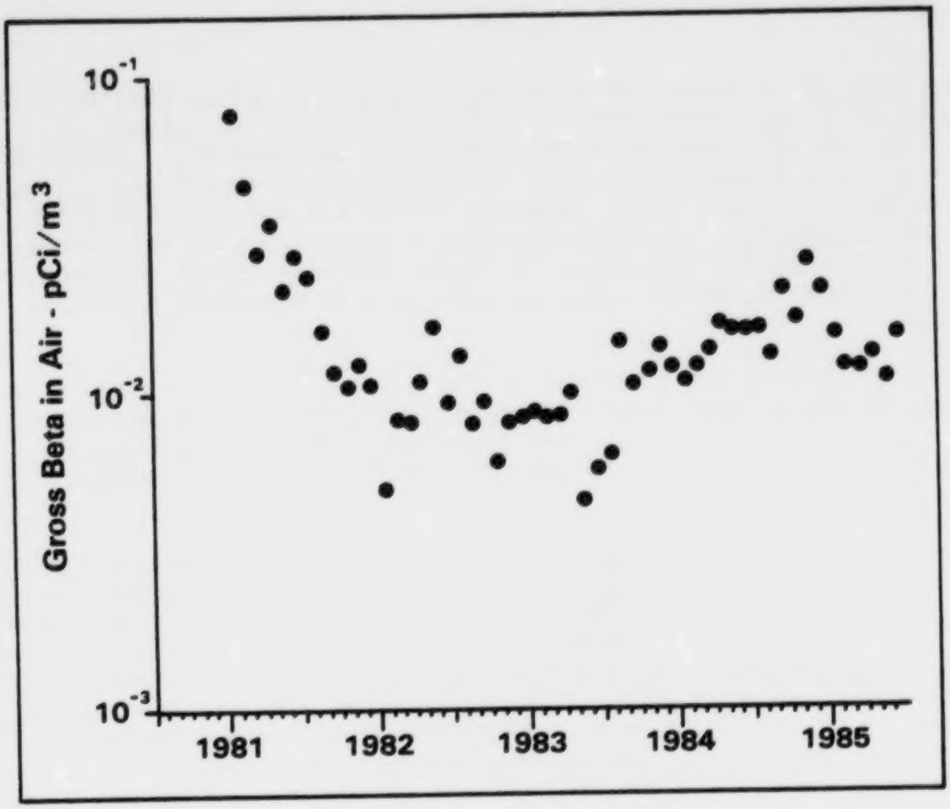


Figure 4. Monthly average gross beta in air samples, 1981-85.

For tritium sampling, a molecular sieve column is used to collect water from air after it passes through a particulate filter. Up to 10 m^3 of air are passed through the column over a 7-day sampling period. Water adsorbed on the molecular sieve is recovered, and the concentration of tritium in the water (HTO) is determined by liquid scintillation counting techniques (see Appendix B).

Results--

The results from the samples collected by the NGTSN are shown in the Appendix (Table E-5) as the maximum, minimum and average concentration for each station. The average krypton-85 concentration per station ranged from 29 to 31 pCi/m^3. The concentration over the whole network appeared to have a normal distribution with a mean of 29.4 pCi/m^3 (1.1 Bq/m^3) and a standard deviation of 3.2. The weekly averages for the network are shown in Figure 6. This network average concentration, as shown in Table 2 has gradually increased since sampling began in 1972. This increase, observed at all stations, reflects the worldwide increase in ambient concentrations resulting from the increased use of nuclear technology. The increase in ambient krypton-85 concentration was projected by Bernhardt, et al., (Be73). However, the measured network average in 1985 is only about 13% percent of the 250 pCi/m^3 (9 Bq/m^3) predicted by Bernhardt. Since nuclear fuel reprocessing is the primary source of krypton-85, the decision of the

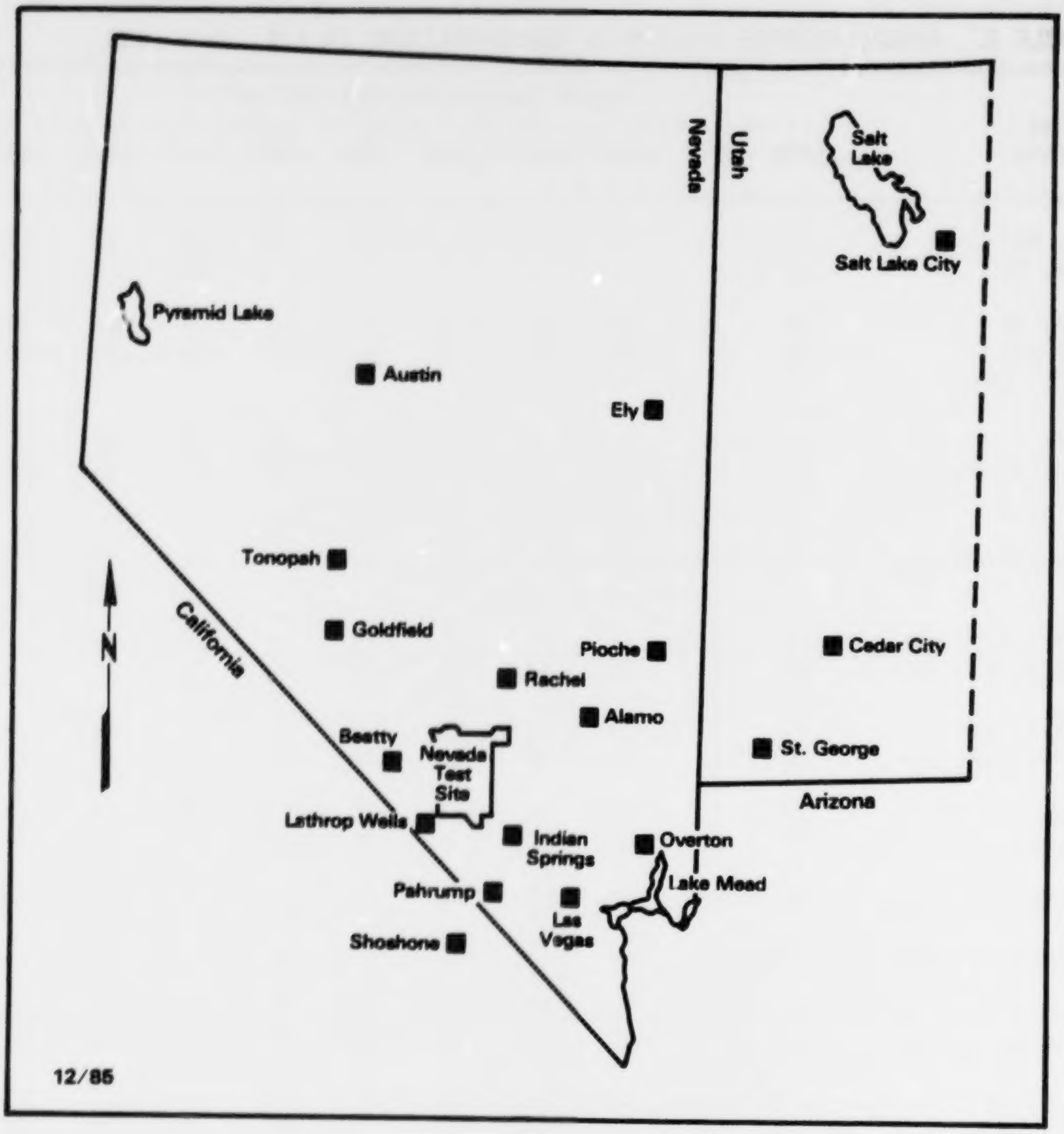

Nevada
Utah
Salt Lake
Salt Lake City
Pyramid Lake
Austin
Ely
Tonopah
Goldfield
N
California
Pioche
Cedar City
Rachel
Alamo
Beatty
Nevada Test Site
St. George
Arizona
Lathrop Wells
Indian Springs
Overton
Lake Mead
Pahrump
Las Vegas
Shoshone
12/85

Figure 5. Noble Gas and Tritium Surveillance Network sampling locations.

TABLE 2. ANNUAL AVERAGE KRYPTON-85 CONCENTRATIONS IN AIR, 1976-1985

Sampling Locations	Kr-85 Concentrations (pCi/m^3)									
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Alamo, NV	--	--	--	--	--	27	24	25	28	29
Austin, NV	--	--	--	--	--	--	24	25	27	30
Beatty, NV	20	20	20	19	21	24	25	24	26	30
Diablo and Rachel, NV**	19	19	20	19	21	24	26	24	26	30
Ely, NV	--	--	--	--	--	--	24	25	26	29
Goldfield, NV*	--	--	--	--	--	--	25	24	28	30
Hiko, NV*	17	19	20	19	21	24	26	--	--	--
Indian Springs, NV	20	20	20	19	21	24	24	25	25	29
NTS, Mercury, NV*	19	20	20	19	21	23	--	--	--	--
NTS, Area 51, NV*	20	19	20	19	21	24	--	--	--	--
NTS, BJY, NV*	20	21	22	21	23	26	--	--	--	--
NTS, Area 12, NV*	20	19	20	19	21	24	--	--	--	--
Tonopah, NV	19	19	20	18	21	25	24	25	26	30
Las Vegas, NV	18	20	20	--	--	24	24	24	27	30
Death Valley Jct., CA*	20	20	20	19	--	--	--	--	--	--
NTS, Area 15, NV*	--	--	--	19	21	25	--	--	--	--
NTS, Area 400, NV*	--	--	--	18	21	23	--	--	--	--
Lathrop Wells, NV	--	--	--	19	22	24	24	26	26	29
Pahrump, NV	--	--	--	--	--	23	24	24	27	30
Overton, Nev.	--	--	--	--	--	26	24	25	26	29
Cedar City, Ut.	--	--	--	--	--	--	25	24	26	29
St. George, Ut.	--	--	--	--	--	--	24	25	26	29
Salt Lake City, Ut.	--	--	--	--	--	--	25	25	29	30
Shoshone, CA	--	--	--	--	--	--	25	25	26	29
NETWORK AVERAGE	19	20	20	19	21	24	24	25	27	29

*Stations discontinued
**Station at Diablo was moved to Rachel in March 1979.

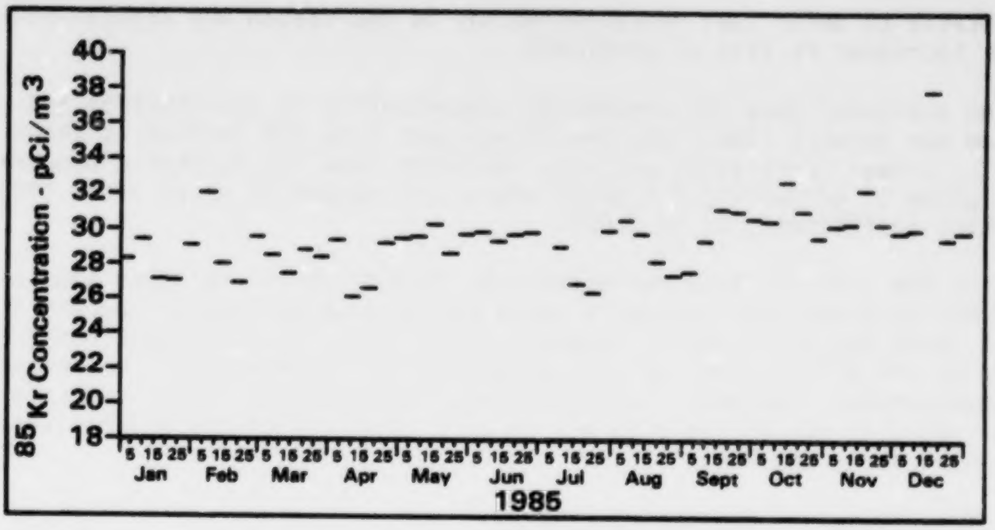


Figure 6. Weekly average krypton-85 concentration in air, 1985 data.

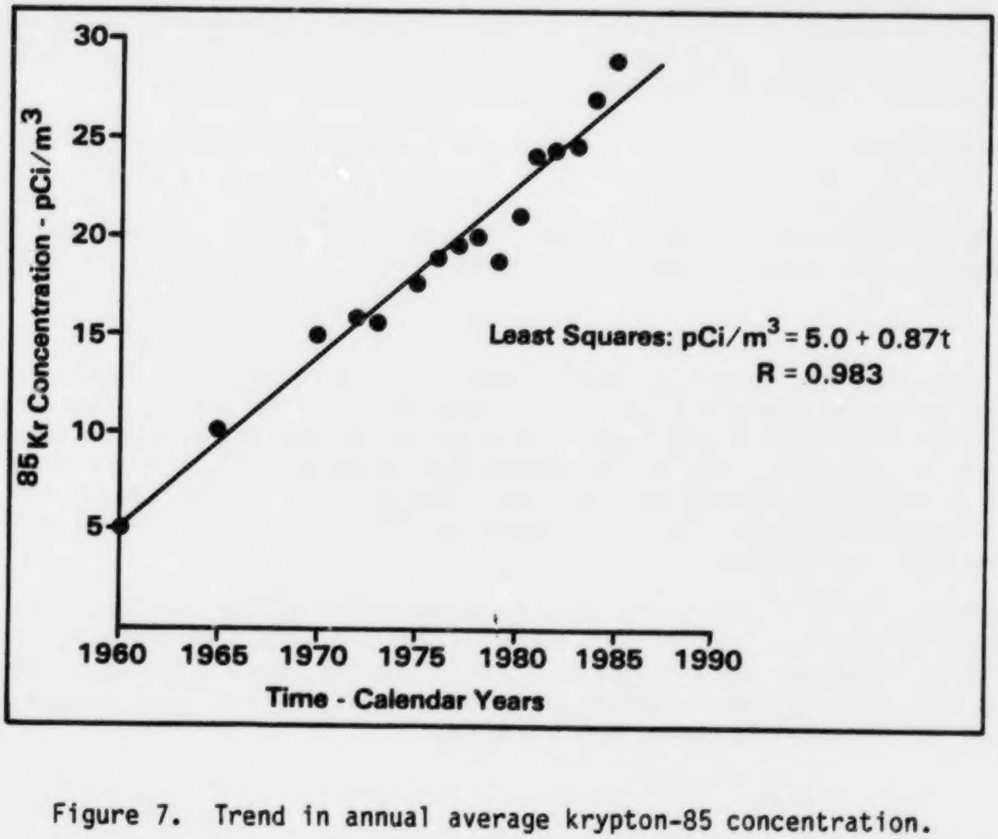


Figure 7. Trend in annual average krypton-85 concentration.

United States to defer fuel reprocessing may be one reason why krypton-85 levels have not increased as fast as predicted.

Using published data for krypton-85 concentration in air (NCRP75) and the data from our network (Table 2), the change over time was plotted as shown in Figure 7. Linear correlation analysis indicates that the krypton concentration/time relation is $pCi/m^3 = 5.0 + 0.87t$ where t is number of years after 1960. The correlation coefficient, R, is 0.983.

As in the past, tritium concentrations in atmospheric moisture samples from the off-NTS stations were generally below the minimum detectable concentration (MDC) of about 400 pCi/L water (Appendix Table E-5). The tritium concentrations observed at off-NTS stations were considered to be representative of environmental background. The mean of the tritium concentrations for all off-site stations was 0.43 pCi/m^3 (16 m Bq/m^3) of air. Only six of the 857 collected samples were above the MDC.

Long-Term Hydrological Monitoring Program

Network Design--

A major pathway for the transport of radionuclides to individuals is via potable water. This program monitors possible radioactive contamination of potable water sources. The design is for a system to monitor the aquifers underlying, and surface waters on or near, sites where nuclear explosions have occurred. For aquifers, monitoring is limited by the availability of wells that tap those sources. For the sites considered herein, a suitable number of wells is present so that sufficient monitoring data are obtained.

The monitored locations for the NTS and nearby off-site areas are shown in Figures 8 and 9. For Projects Cannikin, Longshot and Milrow in Alaska; for Projects Rio Blanco and Rulison in Colorado; for Project Dribble in Mississippi; for Projects Faultless and Shoal in Nevada; and for Projects Gasbuggy and Gnome in New Mexico, the sampling locations are shown in Figures E-1 through E-12 in Appendix E.

Methods--

At each sampling location, four samples are collected. Two samples are collected in 500-mL glass bottles; one is used for tritium analysis and the other stored for use as a duplicate sample or to replace the original sample if it is lost in analysis. Two 3.5-L samples are filtered through 10 cm diameter membrane filters into cubitainers and acidified with HNO_3. One sample and the filter are gamma-scanned, the other sample is stored for duplicate analysis or for reanalysis as required.

Beginning in July 1984, this procedure was modified for the locations around the NTS which had been sampled semi-annually and annually. At these locations, the sampling frequency was changed to monthly and the above sampling procedure was used only twice a year. During the other months, only a 3.5-L sample was collected for analysis by gamma spectrometry.

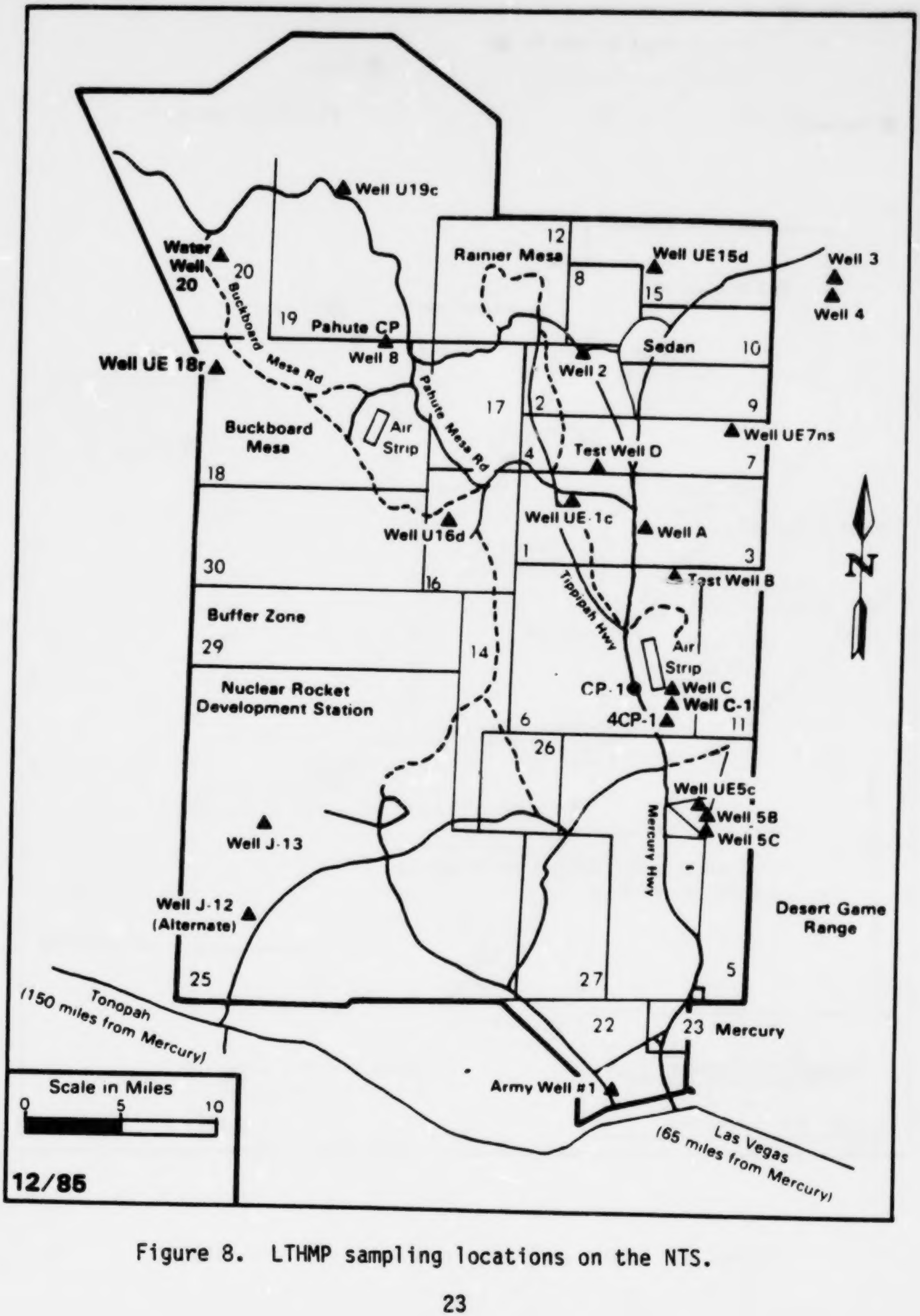

Well U19c
12
Rainier Mesa
Well UE15d
Well 3
Well 4
Water Well 20
20
Buckboard Mesa Rd
19
Pahute CP
Well 8
8
15
Sedan
10
Well UE 18r
Well 2
2
17
9
Buckboard Mesa
Air Strip
Pahute Mesa Rd
Well UE7ns
4
Test Well D
7
18
Well U16d
Well UE-1c
Well A
1
3
30
16
Test Well B
Tippipah Hwy
N
Buffer Zone
29
14
Air Strip
Nuclear Rocket Development Station
CP-1
Well C
Well C-1
6
4CP-1
11
26
Well UE5c
Well 5B
Well 5C
Mercury Hwy
Well J-13
Well J-12 (Alternate)
Desert Game Range
25
27
5
Tonopah (150 miles from Mercury)
22
23
Mercury
Army Well #1
Scale in Miles
0
5
10
Las Vegas (65 miles from Mercury)
12/85

Figure 8. LTHMP sampling locations on the NTS.

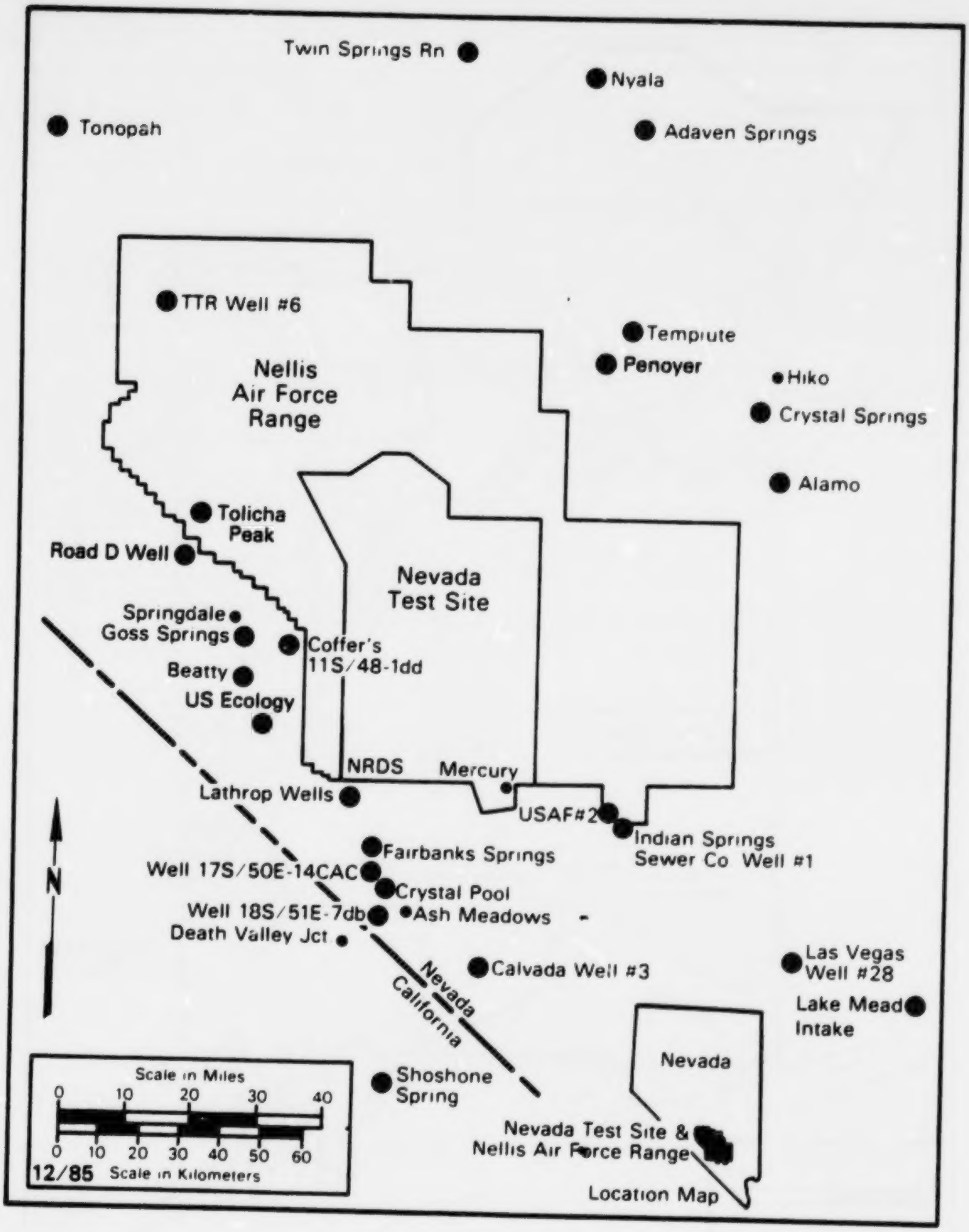

Twin Springs Rn
Nyala
Tonopah
Adaven Springs
TTR Well #6
Tempiute
Penoyer
Hiko
Nellis Air Force Range
Crystal Springs
Alamo
Tolicha Peak
Road D Well
Nevada Test Site
Springdale
Goss Springs
Coffer's 11S/48-1dd
Beatty
US Ecology
NRDS
Mercury
Lathrop Wells
USAF#2
Indian Springs Sewer Co Well #1
Fairbanks Springs
Well 17S/50E-14CAC
Crystal Pool
Well 18S/51E-7db
Ash Meadows
Death Valley Jct
N
Las Vegas Well #28
Calvada Well #3
Nevada
California
Lake Mead Intake
Nevada
Scale in Miles
0
10
20
30
40
Shoshone Spring
Nevada Test Site &
Nellis Air Force Range
0
10
20
30
40
50
60
12/85
Scale in Kilometers
Location Map

Figure 9. LTHMP sampling locations near the NTS.

The tritium and gamma spectrometric analyses are described in Appendix B. If the tritium concentration detected by the conventional analysis is less than 700 pCi/L (26 Bq/L) then the sample is reanalyzed using the enrichment method.

Results--

Table 3 lists the locations at which water samples were found to contain man-made radioactivity. Radioactivity in samples collected at most of these locations has been reported in previous years, the data for all samples analyzed are compiled in Appendix Tables E-6 and E-7 together with the percent of the relevant concentration guide listed in Appendix D. Radiochemical analyses of water samples from 10 new stations indicate only normal concentrations of uranium and radium.

None of the radionuclide concentrations found at the locations listed in Table 3 are expected to result in measurable radiation exposures to residents in the areas where the samples were collected. Well UE7NS and Test Well B are located on the NTS, and are not used as sources of domestic water.

USGS Wells 4 and 8, which were contaminated with the reported nuclides during tracer studies years ago, are on private land at the Project Gnome site in New Mexico and are closed and locked to prevent their use. Well LRL-7 was used for the disposal of contaminated soil and salt so this well is expected to produce contaminated water.

The Project Dribble wells in Mississippi are about 1 mile from the nearest residence and are not sources of drinking water.

The shallow wells at the Project Long Shot site on Amchitka Island in Alaska are in an isolated location and are not sources of drinking water.

Milk Surveillance Network (MSN)

Network Design--

An important pathway for transport of radionuclides to humans is the air-forage-cow-milk chain. This pathway is monitored by EMSL-LV through analysis of milk. The design of the network is based on collections from areas likely to be affected by accidental releases from the NTS as well as from areas unlikely to be so affected. Additional considerations are: 1) a complete ring of stations to cover any eventuality, and 2) samples from major milksheds as well as from family cows. The availability of milk cows or goats sometimes restricts sample collection in certain areas.

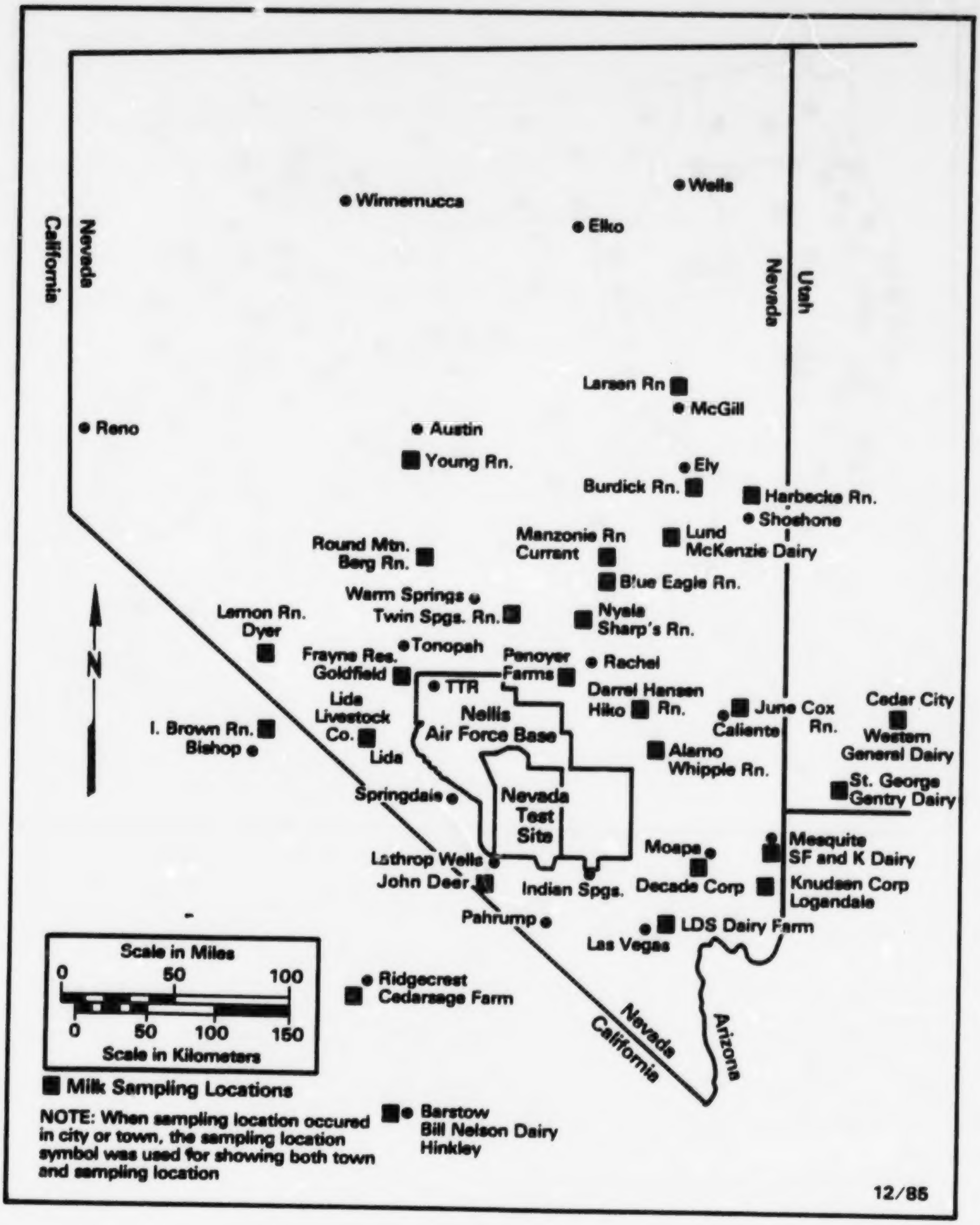
Methods--

The network consists of two major portions, the MSN at locations within 300 km of the NTS from which samples are collected monthly (Figure 10) and the standby network (SMSN) at locations in all major milksheds west of the Mississippi River (Figure 11) from which samples are collected annually. One exception to the latter portion of the network is Texas; the State Health Department performs the surveillance of the milksheds in that State.

The monthly raw milk samples are collected by EPA monitors in 4-liter plastic containers (cubitainers) and preserved with formaldehyde. The annual

TABLE 3. WATER SAMPLING LOCATIONS WHERE SAMPLES CONTAINED MAN-MADE RADIOACTIVITY - 1985

Sampling Location	Type of Radioactivity	Concentration (pCi/L)
NTS, NV		
Test Well B	Hydrogen-3	140-170
Well UE7NS	Hydrogen-3	2000-3100
PROJECT GNOME, NM		
USGS Well 4	Hydrogen-3	260,000
USGS Well 8	Hydrogen-3	190,000
	Cesium-137	58
Well LRL-7	Hydrogen-3	17,000
	Cesium-137	210
PROJECT DRIBBLE, MS		
Well HMH-1 through 11	Hydrogen-3	0-35,000
Well HM-S	Hydrogen-3	16,000
Well HM-L	Hydrogen-3	1,600
REECo Pit Drainage-B	Hydrogen-3	2,500
REECo Pit Drainage-C	Hydrogen-3	1,600
Half Moon Creek Overflow	Hydrogen-3	350
PROJECT LONG SHOT, AK		
Well EPA-1	Hydrogen-3	320
Well WL-2	Hydrogen-3	240
Well GZ, No. 1	Hydrogen-3	2,800
Well GZ, No. 2	Hydrogen-3	170
Mud Pit No. 1	Hydrogen-3	380
Mud Pit No. 2	Hydrogen-3	540
Mud Pit No. 3	Hydrogen-3	500
Stream East of Long Shot	Hydrogen-3	130


Nevada
California
Utah
Nevada
Winnemucca
Wells
Elko
Larsen Rn
McGill
Reno
Austin
Young Rn.
Ely
Burdick Rn.
Harbecke Rn.
Shoshone
Round Mtn.
Berg Rn.
Manzonie Rn
Current
Lund
McKenzie Dairy
Blue Eagle Rn.
Warm Springs
Twin Spgs. Rn.
Nyala
Sharp's Rn.
Lemon Rn.
Dyer
Frayne Res.
Goldfield
Tonopah
Penoyer
Farms
Rachel
TTR
Darrel Hansen
Hiko
Rn.
June Cox
Rn.
Caliente
Cedar City
Western
General Dairy
Lida
Livestock
Co.
Lida
Nellis
Air Force Base
I. Brown Rn.
Bishop
Alamo
Whipple Rn.
St. George
Gentry Dairy
Springdale
Nevada
Test
Site
Mesquite
SF and K Dairy
Moapa
Lathrop Wells
John Deer
Indian Spgs.
Decade Corp
Knudsen Corp
Logandale
Pahrump
LDS Dairy Farm
Las Vegas
Scale in Miles
0
50
100
0
50
100
150
Scale in Kilometers
Ridgecrest
Cedarsage Farm
Nevada
California
Arizona
N
Milk Sampling Locations
Barstow
Bill Nelson Dairy
Hinkley

NOTE: When sampling location occured in city or town, the sampling location symbol was used for showing both town and sampling location

12/85

Figure 10. Milk sampling locations within 300 km of the NTS.

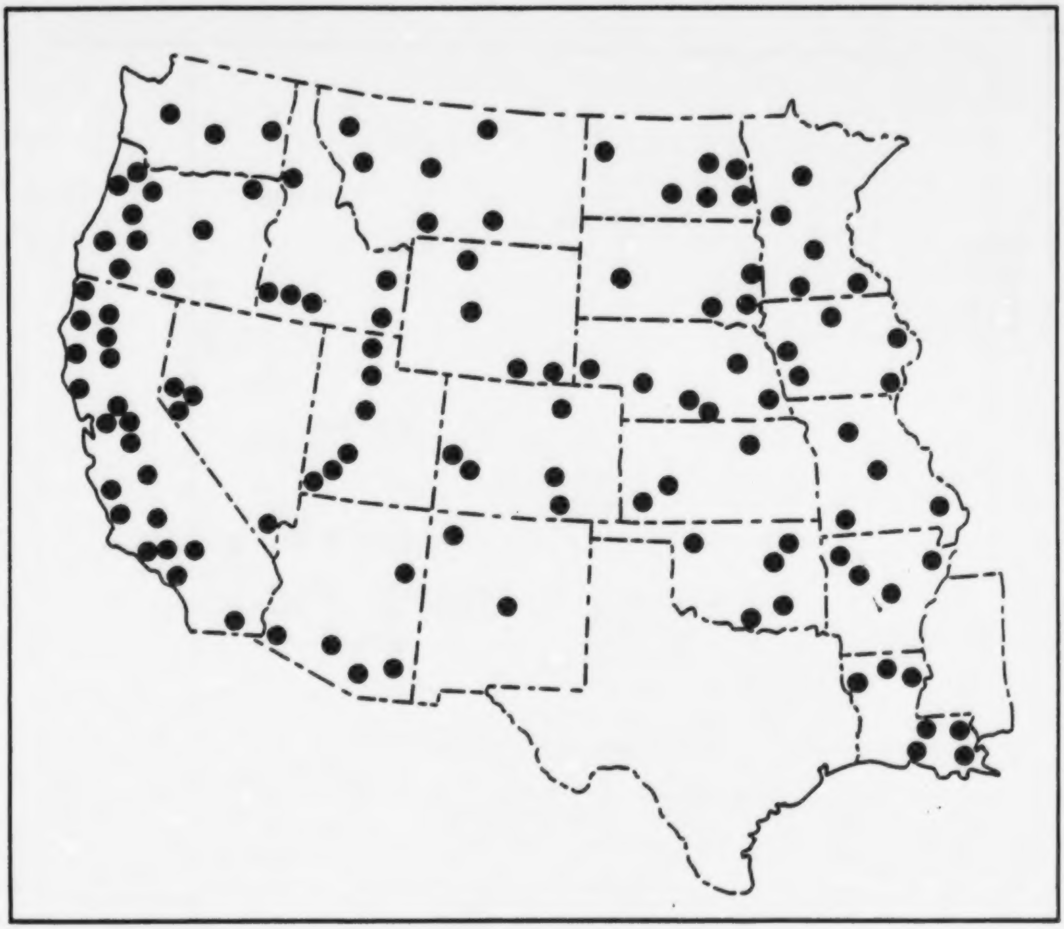


Figure 11. Standby milk surveillance network stations.

milk samples are also collected in cubitainers and preserved with formaldehyde but they are collected by contacting State Food and Drug Administration Representatives, after notification of the Regional EPA offices, who arrange for the samples to be mailed to EMSL-LV.

All the milk samples are analyzed first for gamma-emitting nuclides by high-resolution gamma spectrometry and periodically for strontium-89 and strontium-90 by the methods outlined in Appendix B, after a portion of milk is set aside for tritium analysis. Occasionally a milk sample will sour, thus preventing its passage through the ion exchange column and its subsequent strontium analysis; however, the other analyses can generally be performed satisfactorily. For the SMSN, two locations in each State are selected for tritium and strontium analyses.

Results--

The analytical results from the 1985 MSN samples are summarized in Appendix Table E-8 where the maximum, minimum, and average concentrations of tritium, strontium-89 and strontium-90 are shown for each sampling location. As shown in Table 4, the average concentrations of tritium and strontium-90 for the whole network are similar to the network averages for previous years. The results obtained from the standby network are listed in Table E-9.

TABLE 4. NETWORK ANNUAL AVERAGE CONCENTRATIONS OF TRITIUM AND STRONTIUM-90 IN MILK, 1975-1985

	Average Concentrations - pCi/L	
Year	H-3	Sr-90
1975	<400	<3
1976	<400	<2
1977	<400	<2
1978	<400	1.2
1979	<400	<3
1980	<400	<2
1981	<400	1.9
1982	<400	1.2
1983	<400	0.8
1984	<400	0.5
1985	<400	0.7

Other than naturally occurring potassium-40, radionuclides were not detected by gamma spectrometry in any of the samples from the MSN.

The tritium and strontium-90 concentrations for the whole milk network were plotted versus probits. The tendency of the data to fit one straight line indicates that the data represent a single source, which appears to be atmospheric deposition. These results are consistent with the results obtained for the Pasteurized Milk Network shown in Figure 12. The consistently higher results from New Orleans reflect the higher rainfall in that area. That network is operated by the Eastern Environmental Radiation Facility in Montogmery, Alabama.

Biomonitoring Program

Objective--

The pathways for transport of radionuclides to man include air, water, and food. Monitoring of air, water, and milk are discussed above. Meat is a food component that may be a potential route of exposure to off-site residents.

Methods--

Samples of muscle, lung, liver, kidney, blood, and bone are collected periodically from cattle purchased from a commercial herd that grazes areas northeast of the NTS. These samples are analyzed for gamma-emitters, tritium, strontium, and plutonium. Also, each November and December, bone and kidney samples from desert bighorn sheep collected throughout southern Nevada (see Figure 13) are donated by licensed hunters and are analyzed. These kinds of samples have been collected and analyzed for up to 28 years to determine long term trends.

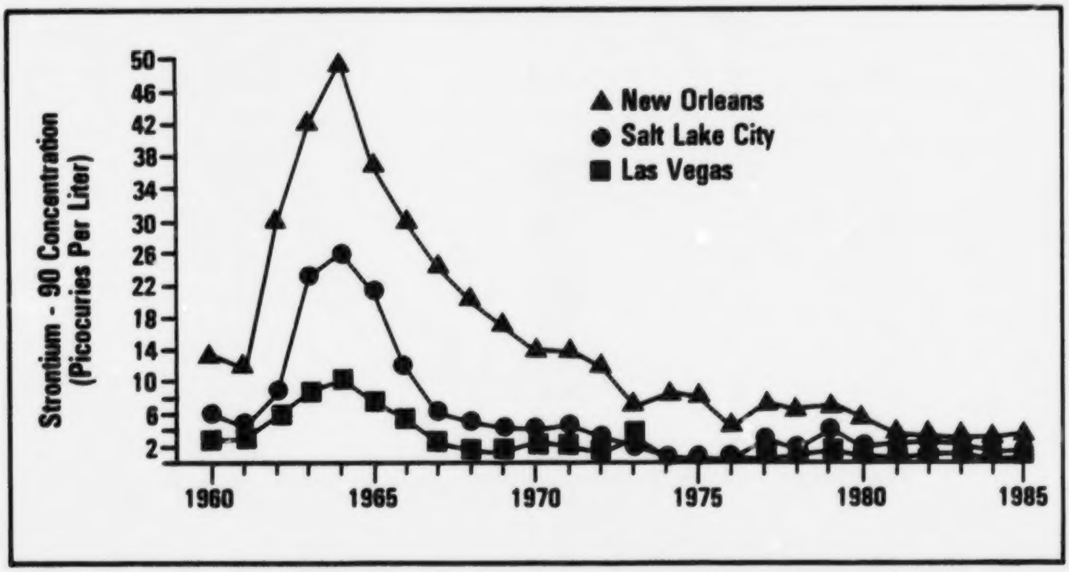
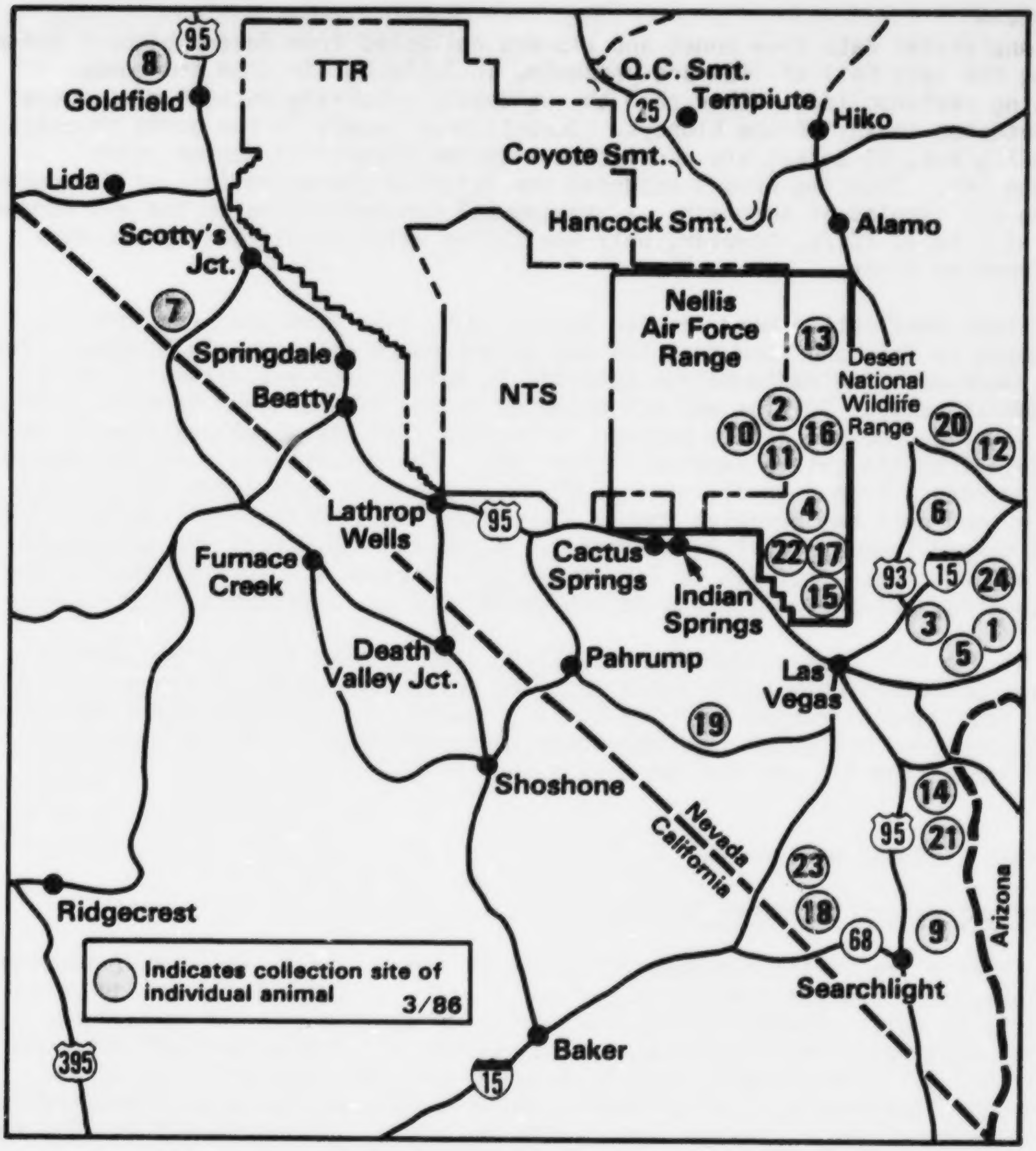


Figure 12. Strontium-90 concentration in Pasteurized Milk Network samples.


TTR
Q.C. Smt.
Tempiute
Hiko
Goldfield
Coyote Smt.
Lida
Hancock Smt.
Alamo
Scotty's Jct.
Nellis Air Force Range
Desert National Wildlife Range
Springdale
Beatty
NTS
Lathrop Wells
Furnace Creek
Cactus Springs
Indian Springs
Death Valley Jct.
Pahrump
Las Vegas
Shoshone
Nevada
California
Arizona
Ridgecrest
Searchlight
Baker
95
25
93
15
68
395
1
2
3
4
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7
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25
Indicates collection site of individual animal
3/86

Figure 13. Collection sites for bighorn sheep samples.

Results--

Analytical data from bones and kidneys collected from desert bighorn sheep during the late Fall of 1984 are presented in Table 5. Tritium and gamma-emitting radionuclides, other than the naturally occurring potassium-40, were not detected in any of the kidneys. Strontium-90 levels in the bones (average 1.6 pCi/g ash, 59 Bq/kg) are consistent with the reports in recent years (Figure 14). Counting errors exceeded the reported concentrations of plutonium-238 in all samples of bone ash. Plutonium-239 concentrations in the ash ranged from -1.1 to 31 fCi/g, however, only the latter value significantly exceeded the counting error.

Eight beef cattle were sampled during 1985; four from the Orin Nash ranch collected in May, and four from the Jay Wright ranch collected in October. The only gamma-emitting radionuclide detected in soft tissue was naturally occurring potassium-40. Tritium was not detected in any of the blood samples. The bone samples from the cattle sampled in October 1984 have been analyzed as well as those from the cattle sampled in May 1985. The results are: Pu-239 concentration ranged from 4 to 41, average 23 fCi/g ash (0.8 Bq/kg) for the October samples and only one positive result, 1.9 fCi/g ash, for the May samples. The Sr-90 ranged from 1.4 to 1.9, average 1.7 pCi/g ash (63 Bq/kg) for the October samples and ranged from 1.6 to 2.2, pCi/g ash, average 2.0, pCi/g ash, for the May samples. Plutonium-238 and strontium-89 were not detectable in any sample.

Of the soft tissue samples, only liver samples from the October 1984 collection contained detectable activity. The concentration of plutonium-239 in those four samples ranged from 3.2 to 7.8, median of 3.6 fCi/kg (0.13 mBq/kg). No samples were collected from mule deer, however, Giles' study of mule deer migration on the NTS was published this year (Gi85).

EXTERNAL EXPOSURE MONITORING

Thermoluminescent Dosimetry Network

External radiation exposure of people is due primarily to medical sources and to natural sources such as cosmic radiation and naturally occurring radioactivity in soil. Radioactivity from fallout generated by past atmospheric nuclear testing causes approximately 0.6 percent of a person's total exposure. Until 1965, film badges were used to document external exposure, but thermoluminescent dosimeters (TLD) gradually replaced film as the measurement instrument because of their greater sensitivity and precision. From 1970 to 1974 the EMSL-LV used the TLD-12 dosimeter but changed to the TLD-200 in 1975.

Network Design--

The TLD network is designed to measure environmental radiation exposure at a location rather than to an individual because of the many uncertainties associated with personnel monitoring. However, several individuals, some residing within and some residing outside of estimated fallout zones from past nuclear tests at the NTS, have been monitored so that any correlations that may exist between personnel and environmental monitoring could be obtained. The network consists of 129 monitored locations encircling the NTS with some concentration in the area of the estimated fallout zones (Figure 15). This

TABLE 5. RADIONUCLIDE CONCENTRATIONS IN DESERT BIGHORN SHEEP SAMPLES - 1984

Bighorn Sheep (Collected Winter 1984)	Bone 90 Sr (pCi/g Ash)	Bone 238 Pu (fCi/g Ash)	Bone 239 Pu (fCi/g Ash)	Kidney K(g/kg)* 3H(pCi/l)‡
1	0.6 ± 0.1	1.0 ± 4.0**	1.3 ± 7.2**	4.5 ± 0.9 60 ± 450
2	2.0 ± 0.1	1.3 ± 3.4**	1.0 ± 2.2**	9.2 ± 1.5 110 ± 450
3	1.1 ± 0.1	0.6 ± 3.5**	-0.6 ± 1.4**	7.6 ± 0.9 40 ± 450
4	1.3 ± 0.1	-0.3 ± 0.3**	0.9 ± 2.1**	2.7 ± 0.8 20 ± 450
5	1.5 ± 0.1	-0.8 ± 3.4**	-1.1 ± 2**	3.3 ± 0.6 20 ± 450
6	1.5 ± 0.1	0.9 ± 4.0**	-0.3 ± 1.9**	8.5 ± 1.0 140 ± 450
7	1.2 ± 0.1	2.4 ± 3.7**	0.4 ± 2.8**	4.4 ± 0.5 450 ± 450
8	1.8 ± 0.1	2.4 ± 5.7**	6.1 ± 5.0	4.4 ± 0.5 250 ± 450
9	3.2 ± 0.4	0.0 ± 4.8**	0.5 ± 3.8**	5.2 ± 0.6 -160 ± 450
10	2.3 ± 0.1	0.5 ± 5.3**	4.4 ± 4.2	4.5 ± 0.6 -180 ± 450
11	1.1 ± 0.1	-5.4 ± 60**	1.6 ± 3.9**	7.0 ± 0.8 -270 ± 450
12	0.8 ± 0.1	2.1 ± 7.8**	0.0 ± 4.2**	3.7 ± 1.2 -120 ± 450
13	2.7 ± 0.1	0.0 ± 4.6**	31.0 ± 16.0	6.7 ± 0.8 40 ± 450
14	0.9 ± 0.1	0.3 ± 3.4**	1.2 ± 2.2**	3.7 ± 0.5 60 ± 450

(continued)

TABLE 5. Continued

Bighorn Sheep (Collected Winter 1984)	Bone 90 Sr (pCi/g Ash)	Bone 238 Pu (fCi/g Ash)	Bone 239 Pu (fCi/g Ash)	Kidney K(g/kg)* 3H(pCi/l)‡
15	3.2 ± 0.1	2.3 ± 6.0**	1.1 ± 4.6**	7.8 ± 0.9 20 ± 450
16	2.3 ± 0.1	0.9 ± 4.6**	4.1 ± 3.8	3.6 ± 0.6 -40 ± 450
17	1.9 ± 0.1	-1.2 ± 3.5**	2.7 ± 2.9**	5.8 ± 0.8 60 ± 450
18	1.2 ± 0.1	1.5 ± 4.9**	4.6 ± 4.1	4.9 ± 0.7 140 ± 450
19	1.4 ± 0.1	0.5 ± 3.2**	1.0 ± 1.9**	5.4 ± 0.7 -120 ± 450
20	1.1 ± 0.1	2.2 ± 4.6**	2.2 ± 2.8**	5.0 ± 0.6 -110 ± 450
21	1.2 ± 0.1	1.2 ± 3.6**	2.7 ± 2.5	NS
22	1.1 ± 0.1	2.8 ± 4.3**	2.1 ± 2.9**	NS
23	1.4 ± 0.1	0.8 ± 3.4**	0.6 ± 1.8**	NS
24	0.9 ± 0.1	-0.5 ± 3.3**	-2.0 ± 4.5**	NS
Median	1.26	0.9	1.2	4.9 30
Range	0.32 - 3.2	-5.4 - 2.8	-1.1 - 3.1	2.7 - 9.2 -270 - 450

* Wet weight.

** Counting error exceeds reported activity.

‡ Aqueous portion of kidney tissue.

NS not sampled.

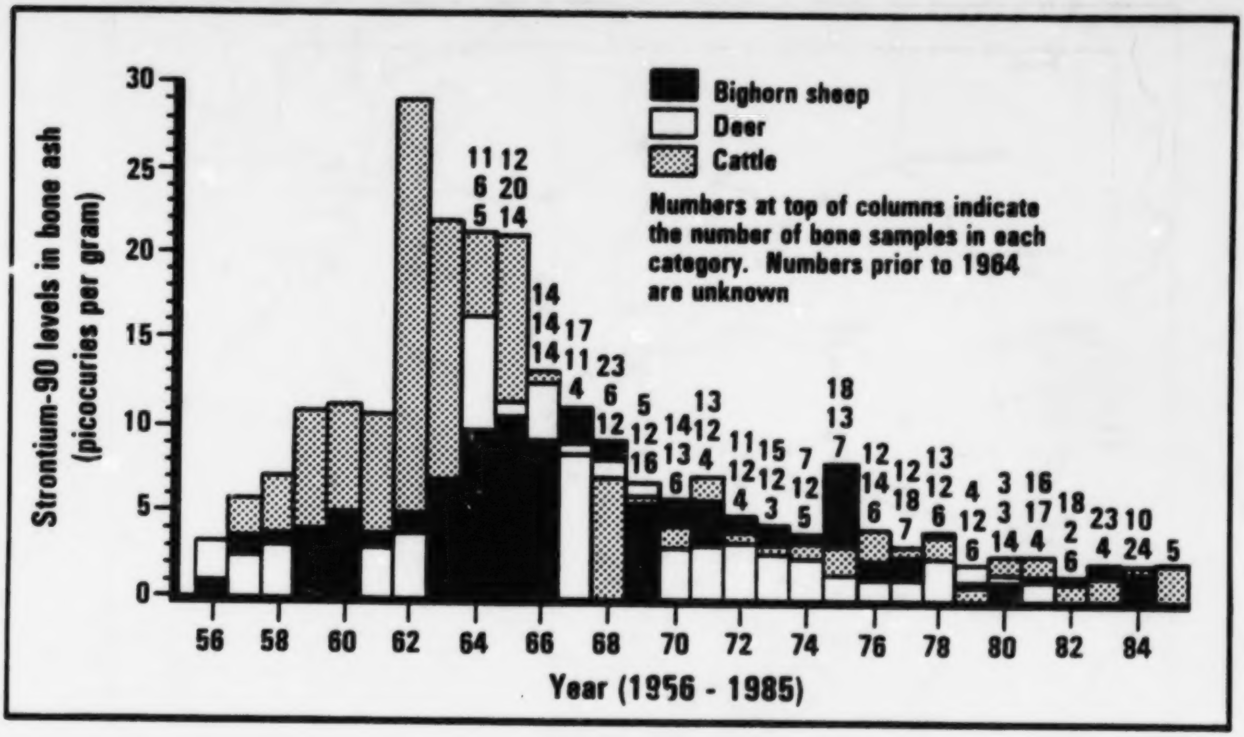

Figure 14. Average strontium-90 concentration in animal bone.

arrangement permits an estimate of average background exposure; yet any increase due to NTS activities can be detected.

Methods--

In 1985 the TLD Network consisted of 129 stations at both inhabited and uninhabited locations within a 500-km radius of the CP-1. Each station is equipped with three Harshaw TLD's to measure gamma exposures resulting from environmental background as well as accidental releases of gamma-emitting radioactivity. Within the area covered by the Network, 52 off-site residents wore dosimeters during 1985. All environmental TLD's were exchanged quarterly, and all personnel TLD's were exchanged monthly.

The Harshaw Model 2271-G2 (TLD-200) dosimeter consists of two small "chips" of dysprosium-activated calcium fluoride mounted in a window of Teflon plastic attached to a small aluminum card. An energy compensation shield of 1.2-mm thick cadmium metal is placed over the card containing the chips, and the shielded card is then sealed in an opaque plastic card holder. Three of these dosimeters are placed in a secured, rugged, plastic housing one meter above ground level at each station to standardize the exposure geometry. One dosimeter is issued to each of 53 off-site residents who are instructed in its proper wearing.

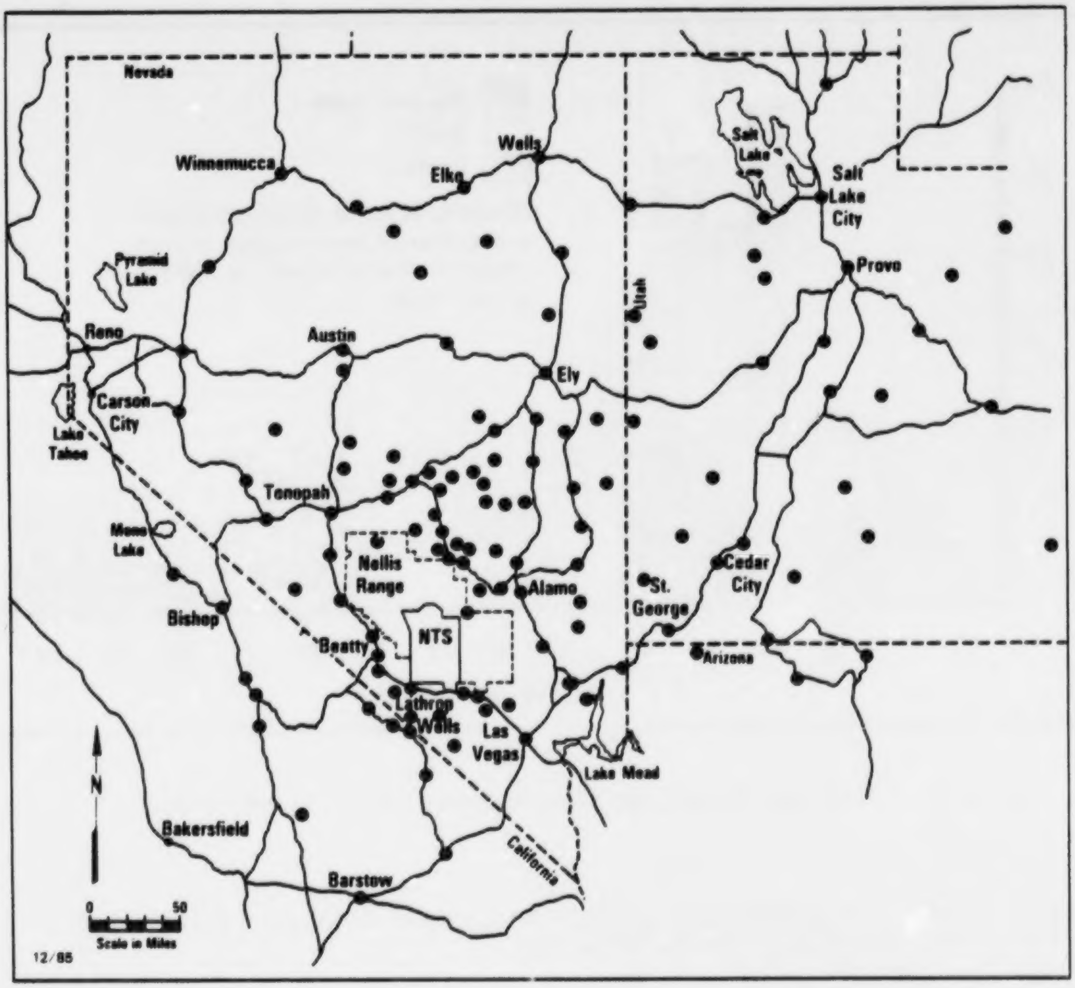
Nevada
Winnemucca
Wells
Elko
Salt Lake
Salt Lake City
Provo
Utah
Pyramid Lake
Reno
Austin
Ely
Carson City
Lake Tahoe
Tonopah
Mono Lake
Nellis Range
Alamo
St. George
Cedar City
Bishop
Beatty
NTS
Arizona
Lathrop Wells
Las Vegas
Lake Mead
N
Bakersfield
California
Barstow
0
50
Scale in Miles
12/85

Figure 15. Locations monitored with TLD's.

After appropriate corrections were made for exposure accumulated during shipment between the laboratory and the monitoring location, and for fading and the response factor, the six TLD chip readings for each station were averaged. The average value for each station was then compared to the values obtained during the previous four quarters at that station to determine whether the new value was statistically different from the previous values. The result from each of the personnel dosimeters was compared to the average background value measured at the nearest fixed station over the previous four quarters.

The smallest exposure above background radiation that can be determined from these TLD readings depends primarily on the magnitude of variations in the natural background exposure rate at the particular station. In the absence of other independent exposure rate measurements, the present exposure rate is compared with valid prior measurements of natural background. Typically, the smallest net exposure detectable at the 99 percent confidence level for a 90-day exposure period would be 1 to 5 mR above background.

Depending on location, the background ranges from 15 to 35 mR per quarter. The term "background," as used in this context, refers to naturally occurring radioactivity plus a contribution from residual manmade fission products, such as worldwide fallout.

Results--

Appendix Table E-10 lists the maximum, minimum, and average dose equivalent rate (mrem/day) and the annual adjusted dose equivalent rate (average in mrem/day times the number of days in the year) measured at each station in the Network during 1985. No allowance was made for the small additional exposure due to the neutron component of the cosmic ray spectrum. No station exhibited an exposure in excess of background during 1985.

Appendix Table E-11 lists the personnel number; associated background station; the maximum, minimum, and average dose equivalent rate (mrem/d); and the annual dose equivalent (mrem) measured for each off-site resident monitored during 1985. Nine dosimeters worn by residents exhibited exposures in excess of background. These exposures are attributed to higher background levels in the residence than at the background station location or to occupational exposure (Nos. 45, 49, 52, 57). Usually, the average dose equivalent rates of the off-site residents is lower than their background stations due to the shielding provided by their homes or places of work.

Table 6 shows that the average annual dose rate for the Dosimetry Network is consistent with the Network average established in 1975. Annual doses decreased from 1971 to 1975 with a leveling trend since 1975, except for a high bias in the 1977 results attributed to mechanical readout problems. The trend shown by the Network average is indicative of the trend exhibited by individual stations, although this average is also affected by the mix of stations at different altitudes (note Figure 16).

Because of the great range in the results, 40 to 142 mrem, an average for the whole area monitored may be inappropriate for estimating individual exposure. This would be particularly true if the exposure of a particular resident were desired. Since environmental radiation exposure can vary markedly with both

TABLE 6. DOSIMETRY NETWORK SUMMARY FOR THE YEARS 1971 - 1985

	Environmental Radiation Dose Rate (mrem/y)		
Year	Maximum	Minimum	Average
1971	250	102	160
1972	200	84	144
1973	180	80	123
1974	160	62	114
1975	140	51	94
1976	140	51	94
1977	170	60	101
1978	150	50	95
1979	140	49	92
1980	140	51	90
1981	142	40	90
1982	139	42	88
1983	140	42	87
1984	133	35	85
1985	142	40	85

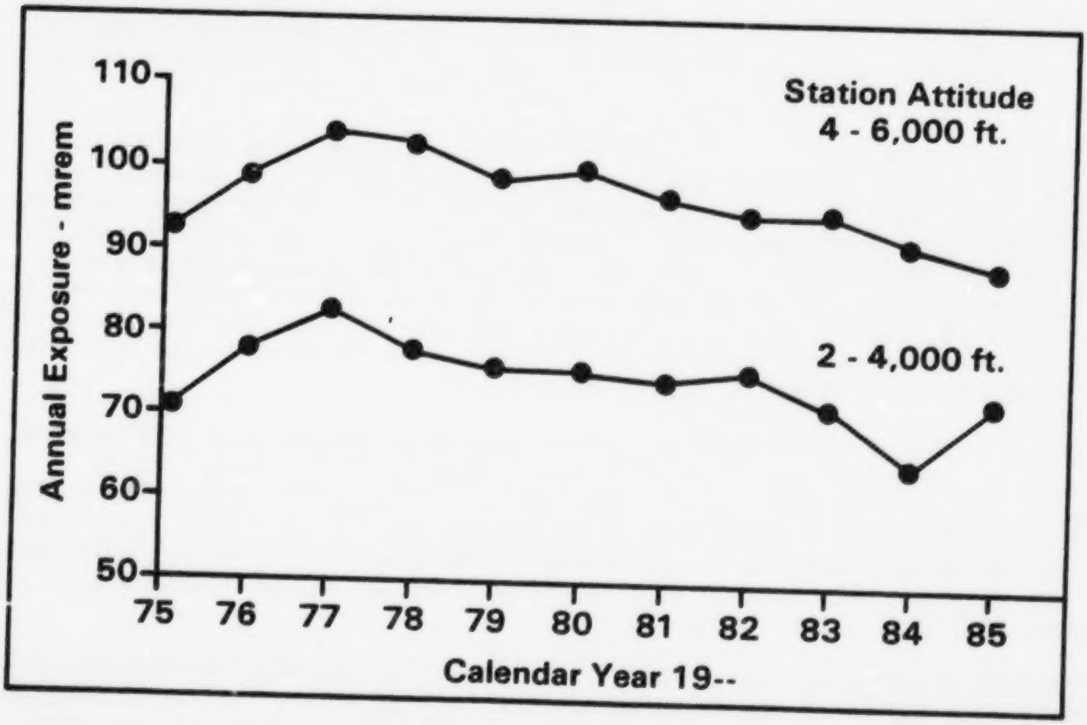

Figure 16. Average annual TLD exposure as a function of station altitude.

altitude and the natural radioactivity in the soil, and since the altitude of the TLD station location is relatively easy to obtain, the measured dose rates for 1975 to 1985 were plotted as a function of altitude. As most of Nevada lies between 2,000 and 6,000 feet above mean sea level, this range was used and was split into two sections for plotting purposes. The results, shown in Figure 16, indicate that the average exposure at altitudes between 4,000 and 6,000 feet is about 20 mrem/yr (0.2 mSv/yr) higher than that at altitudes between 2,000 and 4,000 feet, although both curves follow the same trend as the overall averages listed in Table 6. Thus, if an individual does not live near a monitored location, an estimate of exposure could be based on the altitude of his residence rather than on the average for the whole area monitored.

Pressurized Ion Chamber Network (PIC)

This network is located at the 15 Community Monitoring Stations identified on Figure 2 plus stations at Complex I, Furnace Creek, Nyala, Pioche, Stone Cabin Ranch, Tikaboo Valley, Twin Springs, and Lathrop Wells. The PIC used is manufactured by Reuter-Stokes. The output is displayed on both a paper tape and a digital readout, so the station manager can observe the response. All data is stored on cassette tapes which are read into a computer at EMSL-LV each week. The computer output consists of a table containing hourly, daily, and weekly summaries of the maximum, minimum, average, and standard deviation of the gamma exposure rate.

The data for 1985 are displayed in Table 7 as the average μR/hr and annual mR from each station. When these data are compared to the TLD results for the same 23 stations, it is found that the PIC response is about 28% higher than the TLD response. This is attributed, primarily, to the difference in energy response of the two instruments.

INTERNAL EXPOSURE MONITORING

Internal exposure is caused by ingested or inhaled radionuclides that remain in the body either temporarily or for longer times because of storage in tissues. At EMSL-LV two methods are used to detect such body-burdens: whole-body counting and urinalysis.

The whole-body counting facility has been maintained at EMSL-LV since 1966 and is equipped to determine the identity and quantity of gamma-emitting radioactive materials which may have been inhaled or ingested into the body. A single thallium-activated sodium iodide crystal, 28 x 10 centimeters, is used to measure gamma radiation having energies ranging from 0.1 to 2.5 MeV. Two phoswich detectors are available and can be placed on the chest to measure low-energy radiation - for example, 17 KeV X-rays from plutonium-239. The most likely mode of intake for most alpha-emitting radionuclides is inhalation, and the most important of these radionuclides also emit low-energy X-rays which can be detected in the lungs by the phoswich detectors. An additional phoswich detector is used to determine low-energy radionuclide concentrations in bone, by moving the detector around the skull.

TABLE 7. PRESSURIZED ION CHAMBER READINGS - μR/HOUR

		EXPOSURE RATE (MICRO-R/H)*			ANNUAL ADJUSTED EXPOSURE
STATION LOCATION	MEASUREMENT PERIOD	MAX.	MIN.	AVG.	(MR/Y)
ALAMO, NV	85/01/01-85/12/31	18.5	8.0	13.55	119
AUSTIN, NV	85/01/03-85/12/31	25.2	2.0	17.98	158
BEATTY, NV	85/01/01-85/12/31	19.6	14.8	16.29	143
CEDAR CITY, UT	85/01/01-85/12/31	15.8	6.0	10.49	92
COMPLEX 1, NV	85/01/01-85/12/31	24.5	15.0	17.99	158
ELY, NV	85/01/01-85/12/31	18.7	8.6	12.12	106
FURNACE CREEK, CA	85/01/01-85/12/31	15.7	1.2	9.97	87
GOLDFIELD, NV	85/01/01-85/12/31	24.8	9.8	13.56	119
INDIAN SPRINGS, NV	85/01/01-85/12/31	12.5	7.2	8.23	72
LAS VEGAS, NV (UNLV)	85/01/01-85/12/31	9.5	5.7	6.82	60
LATHROP WELLS, NV	85/01/01-85/12/31	21.8	10.3	13.56	119
NYALA, NV	85/01/01-85/12/31	18.1	10.5	12.54	110
OVERTON, NV	85/01/01-85/12/31	12.8	7.1	8.35	73
PAHRUMP, NV	85/01/01-85/12/31	12.0	2.0	7.67	67
PIOCHE, NV	85/01/01-85/12/31	16.7	11.4	12.80	112
RACHEL, NV	85/01/01-85/12/31	22.2	9.7	16.49	144
SALT LAKE CITY, UT	85/01/01-85/12/31	40.0	1.7	11.20	98
SHOSHONE, CA	85/01/01-85/12/31	14.6	10.3	11.34	99
ST. GEORGE, UT	85/01/01-85/12/31	13.5	5.0	8.74	77
STONE CABIN RNCH, NV	85/01/01-85/12/31	22.8	13.0	16.57	145
TIKABOO VALLEY, NV	85/01/01-85/12/31	21.9	10.0	16.26	142
TONOPAH, NV	85/01/01-85/12/31	29.2	14.1	17.11	150
TWIN SPRGS RANCH, NV	85/01/01-85/12/31	21.2	12.8	17.06	149

*The MAX and MIN values are obtained from the instantaneous readings.

Network Design

This activity consists of two portions, an Off-Site Human Surveillance Program and a Radiological Safety Program. The design for the Off-Site Human Surveillance Program is to measure radionuclide body-burdens in a representative number of families who reside in areas that were subjected to fallout during the early years of nuclear weapons tests. A few families who reside in areas not affected by such fallout were also selected for comparative study. The principal constraint to the program is the cooperation received from the people in the area of study.

The Radiological Safety Program portion requires all employees who may be exposed to radioactive materials in the course of their work to undergo a periodic whole-body count. Some DOE contractor employees are also included in this program.

Methods

The Off-Site Human Surveillance Program was initiated in December 1970 to determine levels of radioactive nuclides in some of the families residing in communities and ranches surrounding the Nevada Test Site. Biannual counting is performed in the spring and fall. This program started with 34 families (142 individuals). In 1985, 16 of these families (37 individuals) were still active in the program together with 18 families added in recent years. The geographical locations of the families which participated in 1985 are shown in Figure 17.

These persons travel to the Environmental Monitoring Systems Laboratory where a whole-body count of each person is made to determine the body burden of gamma-emitting radionuclides. A urine sample is collected for radio-analysis. Results of the whole-body count are available before the families leave the facility and are discussed with the subjects. In November 1985 an agreement was made with REECo Medical Service to do an annual physical examination on participants of the Off-Site Human Surveillance Program. A health history and the following are performed: a urinalysis, complete blood count, serology, chest x ray (3-year intervals), sight screening, audiogram, vital capacity, EKG (over 40 years old), and thyroid panel. The individual is then examined by a physician. The results of the examination can then be requested for use by their family physician.

In addition to the above off-site families, counts are performed routinely on EPA and on contractor's employees as a part of the health monitoring programs. Counts on other individuals in the general population from Las Vegas and other cities are used for comparison.

Results

During 1985, a total of 367 NaI(Tl) and 734 phoswich spectra were obtained from individuals, of whom 106 were participants in the Off-Site Human Surveillance Program. Also, about 2,732 spectra for calibrations and background were generated. Cesium-137 is generally the only fission product detected though none was found in the persons counted this year. Body burdens of Cs-137 in the off-site population detected in previous years were similar to those in other U.S. residents from California to New York. All spectra collected in 1985 were representative of normal background for people and showed only natural potassium-40. No plutonium was detected in any of the phoswich spectra.

The concentration of tritium in urine samples from the off-site residents varied from 0 to 950 pCi/L with an average value of 210 pCi/L (7.8 Bq/L). Nearly all the concentrations measured were in the range of background levels measured in water and reflect only natural exposure. The source for the high values (Salt Lake City residents) is unknown but is not attributed to NTS activities. The tritium concentration in urines from EPA employees had a mean of 270 pCi/L and a range of 60 to 600, average 270 pCi/L (10 Bq/L).

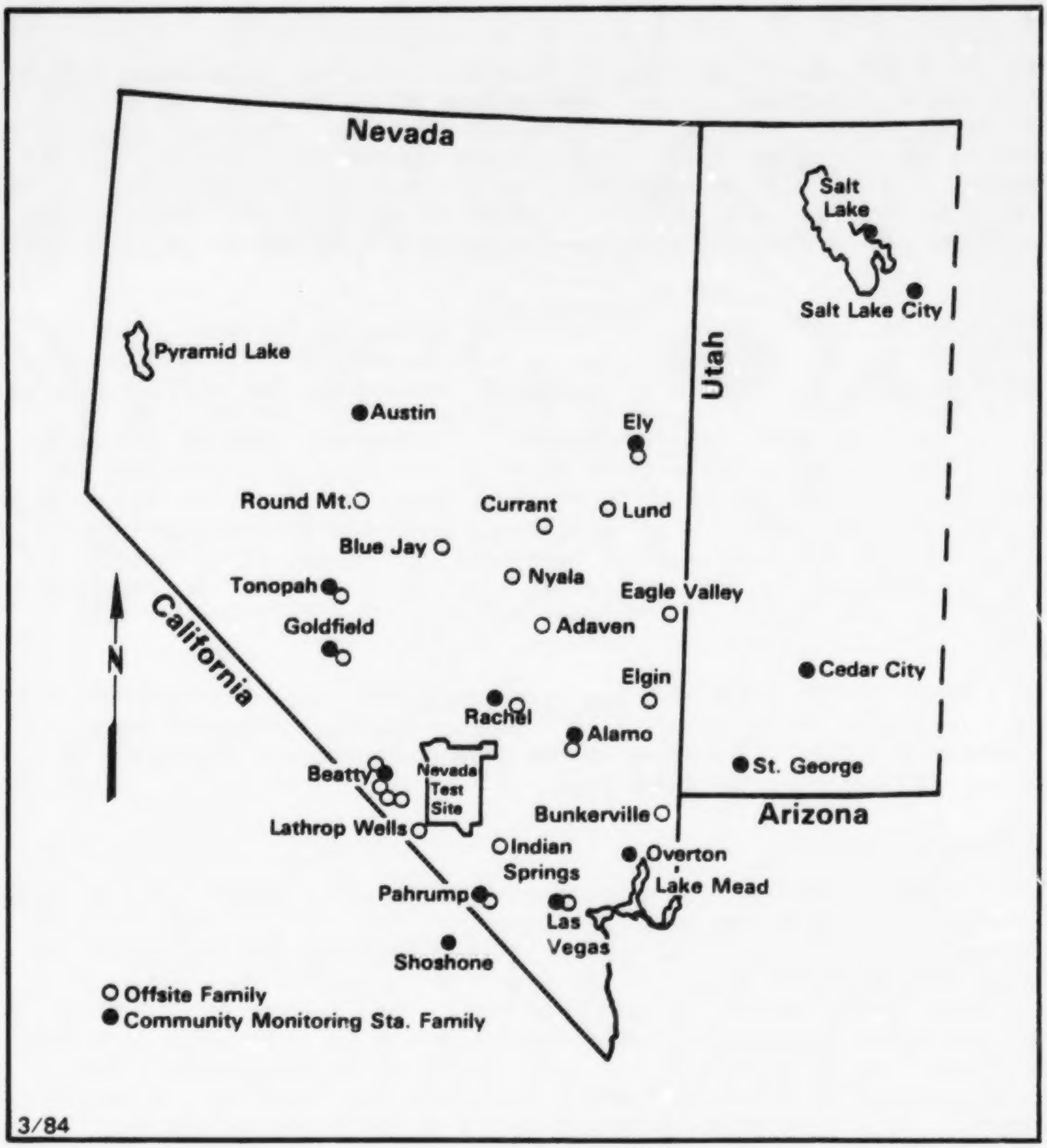
Nevada
Utah
Arizona
California
N
Salt Lake
Salt Lake City
Pyramid Lake
Austin
Ely
Round Mt.
Currant
Lund
Blue Jay
Nyala
Tonopah
Goldfield
Eagle Valley
Adaven
Elgin
Cedar City
Rachel
Alamo
St. George
Beatty
Nevada Test Site
Lathrop Wells
Bunkerville
Indian Springs
Overton
Lake Mead
Pahrump
Las Vegas
Shoshone
○ Offsite Family
● Community Monitoring Sta. Family
3/84

Figure 17. Location of families in the Off-Site Human Surveillance Program.

As reported in previous years, medical examination of the off-site families revealed a generally healthy population. In regard to the hematological examinations and thyroid profiles, no abnormal results were observed which could be attributed to past or present NTS testing operations.

COMMUNITY MONITORING STATIONS

In order to increase public knowledge about and participation in radiological surveillance activities as conducted by DOE and EPA; the DOE, through an Interagency Agreement with EPA and contracts with the Desert Research Institute (DRI) of the University of Nevada and the University of Utah, has established a network of 15 Community Monitoring Stations in the off-NTS areas. Each station is operated by a local resident, in most cases a science teacher, who is trained in radiological surveillance methods by the University of Utah. The stations are equipped and maintained, and samples are collected and analyzed by EMSL-LV. DRI provides data interpretation to the communities involved and pays the station operators for their services.

Each station contains one of the samplers for the ASN, NGTSN and Dosimetry networks discussed earlier, plus a pressurized ion chamber (PIC) and recorder for immediate readout of external gamma exposure, and a recording barograph. All of the equipment is mounted on a stand at a convenient location in each community so the residents are aware of the surveillance and, if interested, can have ready access to the data. The station locations are those indicated in Figure 2.

The data from these stations are included in the tables in Appendix E with the other data from the appropriate networks. Table 7 contains a summary of the PIC data.

CLAIMS INVESTIGATIONS

One of the public service functions of the EMSL-LV is to investigate claims of injury allegedly due to radiation originating from NTS activities. A physician and a veterinarian, qualified by education or experience in the field of radiobiology, investigate claims of radiation injury to determine whether or not radiation exposure may be involved.

Investigation of claims from people involves determining the type of illness, from examining physicians records and diagnoses, and determining the possibility of radiation exposure through residence history and examination of historical radiation surveillance data. These investigations were conducted by the Medical Liaison Officers Network (MLON) or by the EMSL-LV physician (until his retirement in May), depending on where the claim was made. The MLON is composed of physicians, one from each state, who are trained in radiobiology. No claims of radiation injury were made in 1985.

The EMSL-LV veterinarian conducts similar investigations for claims of injury to domestic animals. In most cases the injuries investigated have been due to common causes such as bacterial infections or unusual events such as feeding on halogeton, a poisonous plant. No such claims were made in 1985.

PUBLIC INFORMATION PROGRAM

An important function of the Off-Site Program has been to create and maintain, to the extent possible, public confidence that all reasonable safeguards are being employed to preserve public health and property from possible hazards resulting from nuclear testing. Much of this responsibility is carried out through personal contact with off-site residents by the radiation monitors who advise the residents of program developments and answer questions about test activities.

For any test where ground motion may be perceptible off site, monitors visit remote locations and active mines beforehand to advise operators of possible problems. They also stand by on test day to advise of schedule changes. Mine operators are reimbursed for time lost due to these activities. After the test, monitors inform all their contacts that the test is over and whether or not any radiation was detected off site.

The series of "town hall" meetings, initiated during Fiscal Year 1982 near community monitoring stations was continued for CY 1985. The meetings were organized to familiarize the local citizenry with the NTS nuclear testing and related activities, to show how the surveillance networks function, and to answer questions or expressed concerns of the attending public. During CY85, meetings were held according to the following schedule:

Cedar City, UT	January 23	Pioche, NV	May 23
St. George, UT	January 24	La Verkin, UT	July 9
Henderson, NV	March 13	Washington, UT	July 10
Beaver, UT	April 17	Bunkerville, NV	September 19
Parowan, UT	April 18	Tecopa Hot Springs, CA	October 25
Bullhead City, AZ	April 19	North Las Vegas, NV	December 12
Caliente, NV	May 22		

Other activities included arranging NTS tours for businesses and community leaders in Amargosa Valley, for park rangers of Death Valley, and for EPA employees and spouses. Talks on the deer migration studies were presented for the vocational agriculture classes at White Pine High School, the Wildlife Society and Society for Range Management meetings in Ely, the Pioche Rod and Gun Club, and the Boulder City Horseman's Association. Presentations on the Off-Site Safety Program were given to the Nye County commissioners, the St. George Chamber of Commerce, Twin Springs School, and Pioche Elementary School. The mobile whole body, thyroid, and sample-counting trailer and a replica of a community monitoring station were displayed and demonstrated at the Jaycees State Fair in Las Vegas in October.

With the continued population growth in the off-site area in recent years and the continuing concern for keeping radiation exposures as low as reasonably achievable, the EMSL-LV realized that it would need local government assistance to implement all protective actions that could be needed to protect close-in population centers should an underground nuclear test accidently vent. EMSL-LV staff discussed the kinds of assistance needed with the Nevada State Division of Emergency Management, and obtained the State's concurrence with its plan to work with County emergency management officials to develop modifications or additions to their adopted emergency response plans. These changes would specify protective actions and procedures for implementing them and would serve as formal agreements on Federal and local government responsibilities and authorities.

During 1985, an Appendix to the Radiological Defense Annex of the Esmeralda and White Pine Counties (Nevada) emergency plans was prepared. This Appendix is expected to serve as a model for developing a similar agreement with officials of Clark County and Inyo County, CA. The County plans, with their new appendices, will be annexed to the master plan DOE is developing for off-site emergency response for an accidental venting or seepage at the Nevada Test Site. As part of these plans, 12,000 Film badges were distributed to 13 locations in Lincoln and Nye Counties with the objective of providing personal dosimetry for at least one person per family or about two-thirds of the total population in major population centers. Issue of badges will be performed by county or state personnel in the unlikely event of a significant release of radioactive material from the NTS.

DOSE ASSESSMENT

Dose assessment calculations for NTS-related radioactivity are not possible because detectable levels of radioactivity from the 1985 nuclear testing program at the NTS were not observed off site by any of the monitoring networks. However, an exposure can be calculated by using atmospheric dispersion calculations and reported releases of radioactivity from the NTS (Table 1). This calculation is shown below. Residual radioactivity was observed in waters from wells in other nuclear testing areas known to be contaminated during past nuclear tests at the Project Dribble Site near Hattiesburg, Mississippi; Project Gnome near Malaga, New Mexico; and at the Project Long Shot site on Amchitka Island, Alaska. However, the waters from these contaminated wells are not used for drinking purposes.

An estimate of exposure of an average adult in Nevada due to worldwide radioactivity can be made based on the data from the monitoring networks. The principal data are strontium-90 in milk (28 mBq/L) and plutonium-239 in beef liver (0.29 mBq/kg) from past atmospheric tests; krypton-85 in air from use of nuclear technology (1.1 Bq/m^3); and the average tritium concentration in air (HTO = 16 mBq/m^3).

Assumptions: (ICRP-23)
(1) breathing rate = 8400 m^3/yr,

(2) milk intake (10-year old) = 160 L/yr,

(3) hours per average year = 8766.

From ICRP-30, the committed dose equivalent conversion factors are:

(1) Kr-85 (immersion) - 4.7×10^{-11} Sv/hr per Bq/m^3 to the skin,

$= 4.12 \times 10^{-7}$ Sv/yr per Bq/m^3

$= 1.53 \times 10^{-3}$ mrem/yr per pCi/m^3

(2) Sr-90 (ingestion) - 1.9×10^{-7} Sv/Bq

$= 1.9 \times 10^{-2}$ mrem/Bq

$= 7 \times 10^{-4}$ mrem/pCi,

(3) HTO (inhalation) - 9.9×10^{-15} Sv/hr per Bq/m^3

$= 3.2 \times 10^{-7}$ mrem/yr per pCi/m^3

(4) Pu-239 (ingestion) - 2.1×10^{-6} Sv/Bq

$= 7.8 \times 10^{-3}$ mrem/pCi

Calculated annual dose equivalent:

Kr-85: 1.53×10^{-3} mrem/yr x 29.5 pCi/m^3 = .045 mrem

Sr-90: 7×10^{-4} mrem/pCi x 0.77 pCi/L x 160 L/yr = 0.086 mrem

HTO: 3.2×10^{-7} mrem/yr x 0.43 pCi/m^3 = 1.4×10^{-7} mrem

The highest postulated annual dose equivalent to man as calculated from the Biomonitoring Program would be .0062 mrem. This is based on the assumption that all the liver samples would have the maximum Pu-239 concentration (0.0078 pCi/kg) and that consumption was 0.28 kg/d for 365 days/yr (ICRP-29).

Therefore, the total annual dose equivalent to an adult in Nevada based on the results from the monitoring program would be the sum of the above, or 0.14 mrem (1.4 μSv) at maximum. This is a small fraction of the dose equivalent delivered by the natural radioactive content of the average man.

The external exposures to Nevadans range from 40 to 142 mrem/yr as measured by the TLD network. In the U.S., reported external exposures range from 63 to 200 mrem/a, depending on elevation (sea coast or Rocky Mountains) and on the natural radioactivity in the soil (NCRP71). The exposures measured by the TLD's compare favorably with that range as the TLD station's altitude varies from 500 to over 7,000 feet above MSL and the uranium content in soil probably also varies markedly among stations.

Other than the Xe-133 detected during the planned ventilation of the tunnel following the Misty Rain event, none of the radionuclides released at the NTS as listed in Table 1 were detected off site. The normal 1 week noble gas sample at Rachel had no detectable xenon so that the 11 pCi/m^3 detected on the 1 day sample at Rachel (as stated in the section on Special Test Support) probably was valid only for that day. The skin dose from that concentration would have been about 0.06 μrem or about 0.002% of the background exposure measured by the PIC at Rachel.

Because no significant radioactivity of recent NTS origin was detectable off site by the air, water, milk, TLD or biological monitoring networks, other than as described above, no impact on the population living around the NTS would be expected. However, to substantiate those findings, it is instructive to calculate public exposure from those radionuclides released from the NTS as stated in Table 1. There were no waterborne radioactive effluents and only tritium (116 Ci) and Xe-133 (735 Ci) were released in airborne emissions in significant quantities. Since human exposure to these nuclides is straightforward, a simple atmospheric dispersion calculation will suffice. AIRDOSE-RADRISK, which calculates exposure resulting from multiple transport pathways, is inappropriate for those cases, such as the present one, where a single pathway predominates. The atmospheric dispersion calculation yields a maximum individual dose of 4 x 10^{-5} mrem (4 x 10^{-7} mSv) and a population dose, to the 6500 people living within 80 km of CP-1, of 2 x 10^{-4} person-rem (2 x 10^{-6} person-Sv).

As confirmation of the above results, an AIRDOSE run using the effluents listed in Table 1 yielded a maximum individual dose of 4.2 x 10^{-5} mrem and a population dose of 1.3 x 10^{-4} person-rem, an insignificant difference from the atmospheric dispersion calculation.

SECTION 6

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NOTICE

This report has been reviewed in accordance with the U.S. Environmental Protection Agency's peer and administrative review policies and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

APPENDIX A

SITE DATA

APPENDIX A

SITE DATA

SITE DESCRIPTION

A summary of the uses of the NTS and its immediate environs is included in Section 3 of this report. More detailed data and descriptive maps are contained in this Appendix.

Location

The NTS is located in Nye County, Nevada, with its southeast corner about 90 km northwest of Las Vegas (Figure 1 in main report). It has an area of about 3,500 square km and varies from 40 to 56 km in width (east-west) and from 64 to 88 km in length (north-south). This area consists of large basins or flats about 900 to 1,200 m above mean sea level (MSL) surrounded by mountain ranges rising 1,800 to 2,300 m above MSL.

The NTS is surrounded on three sides by exclusion areas, collectively named the Nellis Air Force Range, which provide a buffer zone between the test areas and public lands. This buffer zone varies from 24 to 104 km between the test area and land that is open to the public. Depending upon wind speed and direction, from 2 to more than 6 hours will elapse before any release of airborne radioactivity could pass over public lands.

Climate

The climate of the NTS and surrounding area is variable, due to its variations in altitude and its rugged terrain. Generally, the climate is referred to as continental arid. Throughout the year, there is insufficient water to support the growth of common food crops without irrigation.

Climate may be classified by the types of vegetation indigenous to an area. According to Houghton et al. (Ho75), this method of classification of dry condition, developed by Doppen, is further subdivided on the basis of temperature and severity of drought. Table A-1 (Ho 1975) summarizes the characteristics of climatic types for Nevada.

According to Quiring (Qu68), the NTS average annual precipitation ranges from about 10 cm at the lower elevations to around 25 cm on the higher elevations. During the winter months, the plateaus may be snow-covered for a period of several days or weeks. Snow is uncommon on the flats. Temperatures vary considerably with elevation, slope, and local air currents. The average daily high (low) temperatures at the lower altitudes are around 50F (25F) in

TABLE A-1. CHARACTERISTICS OF CLIMATIC TYPES IN NEVADA (from Houghton et al. 1975)

	Mean Temperature °C (°F)		Annual Precipitation cm (inches)			
Climate Type	Winter	Summer	Total*	Snowfall	Dominant Vegetation	Percent of Area
Alpine tundra	-18° to -9° (0° to 15°)	4° to 10° (40° to 50°)	38 to 114 (15 to 45)	Medium to heavy	Alpine meadows	--
Humid continental	-12° to -1° (10° to 30°)	10° to 21° (50° to 70°)	64 to 114 (25 to 45)	Heavy	Pine-fir forest	1
Subhumid continental	-12° to -1° (10° to 30°)	10° to 21° (50° to 70°)	30 to 64 (12 to 25)	Moderate	Pine or scrub woodland	15
Mid-latitude steppe	-7° to 4° (20° to 40°)	18° to 27° (65° to 80°)	15 to 38 (6 to 15)	Light to moderate	Sagebrush, grass, scrub	57
Mid-latitude desert	-7° to 4° (20° to 40°)	18° to 27° (65° to 80°)	8 to 20 (3 to 8)	Light	Greasewood, shadscale	20
Low-latitude desert	-4° to 10° (40° to 50°)	27° to 32° (80° to 90°)	5 to 25 (2 to 10)	Negligible	Creosote bush	7

*Limits of annual precipitation overlap because of variations in temperature which affect the water balance.

January and 95F (55F) in July, with extremes of 110F and -15F. Corresponding temperatures on the plateaus are 35F (25F) in January and 80F (65F) in July with ex-15F have been observed.

The wind direction, as measured on a 30 m tower at an observation station about 9 km NNW of Yucca Lake, is predominantly northerly except during the months of May through August when winds from the south-southwest predominate (Qu68). Because of the prevalent mountain/valley winds in the basins, south to southwest winds predominate during daylight hours of most months. During the winter months southerly winds have only a slight edge over northerly winds for a few hours during the warmest part of the day. These wind patterns may be quite different at other locations on the NTS because of local terrain effects and differences in elevation.

Geology and Hydrology

Two major hydrologic systems shown in Figure A-1 exist on the NTS (ERDA77). Ground water in the northwestern part of the NTS or in the Pahute Mesa area has been reported to flow at a rate of 2 m to 180 m per year to the south and southwest toward the Ash Meadows Discharge Area in the Amargosa Desert. It is estimated that the ground water to the east of the NTS moves from north to south at a rate of not less than 2 m nor greater than 220 m per year. Carbon-14 analyses of this eastern ground water indicate that the lower velocity is nearer the true value. At Mercury Valley in the extreme southern part of the NTS, the eastern ground water flow shifts southwestward toward the Ash Meadows Discharge Area.

Land Use of NTS Environs

Figure A-2 is a map of the off-NTS area showing a wide variety of land uses, such as farming, mining, grazing, camping, fishing, and hunting within a 300-km radius of the NTS. For example, west of the NTS, elevations range from 85 m below MSL in Death Valley to 4,420 m above MSL in the Sierra Nevada Range. Parts of two major agricultural valleys (the Owens and San Joaquin) are included. The areas south of the NTS are more uniform since the Mojave Desert ecosystem (mid-latitude desert) comprises most of this portion of Nevada, California, and Arizona. The areas east of the NTS are primarily mid-latitude steppe with some of the older river valleys, such as the Virgin River Valley and Moapa Valley, supporting irrigation for small-scale but intensive farming of a variety of crops. Grazing is also common in this area, particularly to the northeast. The area north of the NTS is also mid-latitude steppe, where the major agricultural activity is grazing of cattle and sheep. Minor agriculture, primarily the growing of alfalfa hay, is found in this portion of the State within 300 km of the NTS Control Point-1 (CP-1). Many of the residents grow or have access to locally grown fruits and vegetables.

Many recreational areas, in all directions around the NTS (Figure A-2) are used for such activities as hunting, fishing, and camping. In general, the camping and fishing sites to the northwest, north, and northeast of the NTS are utilized throughout the year except for the winter months. Camping and fishing locations to the southeast, south, and southwest are utilized throughout the year. The hunting season is from September through January.

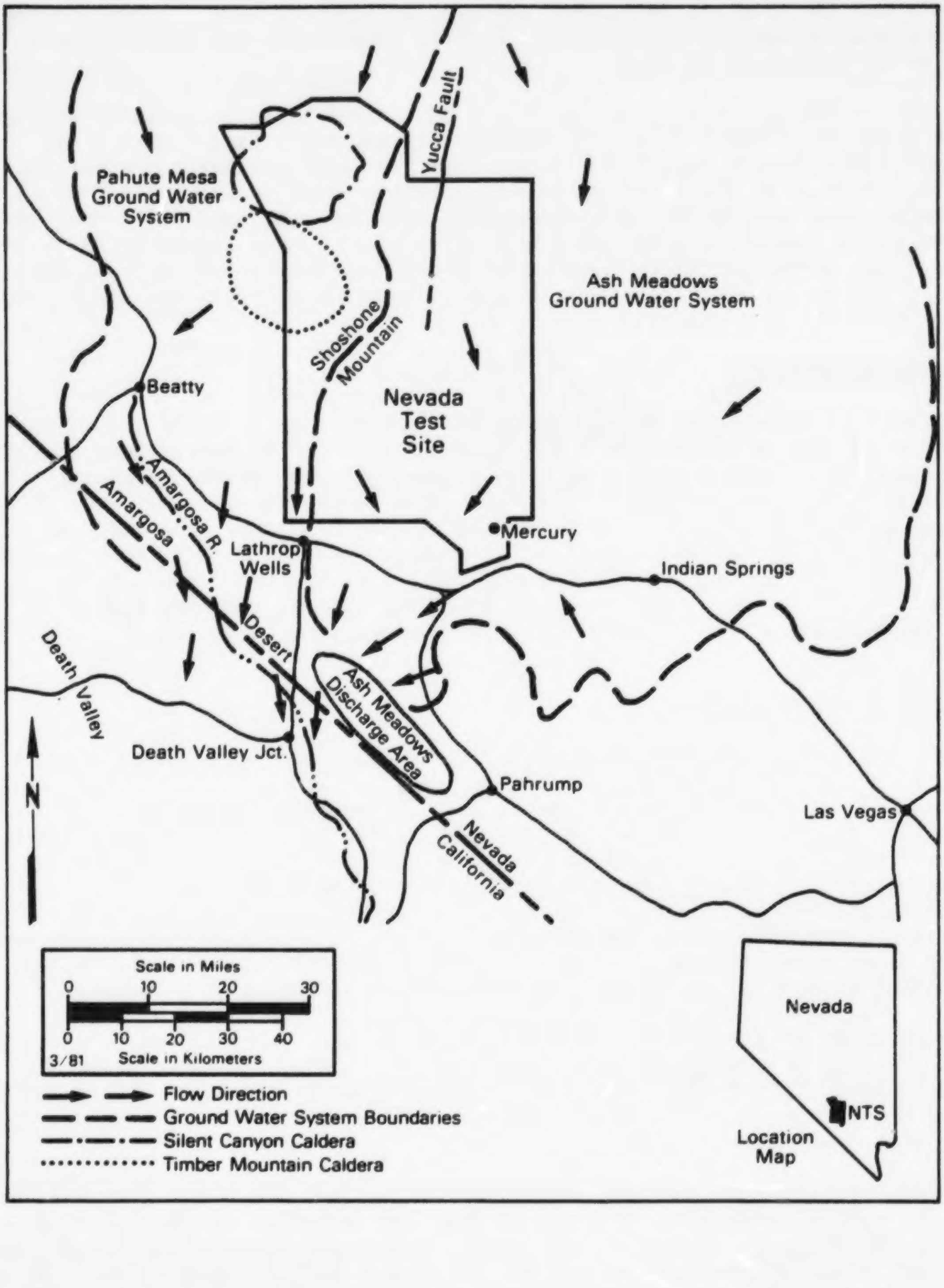
Pahute Mesa Ground Water System
Yucca Fault
Ash Meadows Ground Water System
Shoshone Mountain
Nevada Test Site
Beatty
Amargosa R.
Amargosa
Lathrop Wells
Mercury
Indian Springs
Desert
Death Valley
Ash Meadows Discharge Area
Death Valley Jct.
Pahrump
Las Vegas
Nevada
California
N
Scale in Miles
0
10
20
30
0
10
20
30
40
3/81
Scale in Kilometers
Flow Direction
Ground Water System Boundaries
Silent Canyon Caldera
Timber Mountain Caldera
Nevada
NTS
Location Map

Figure A-1. Ground-water flow systems around the Nevada Test Site.

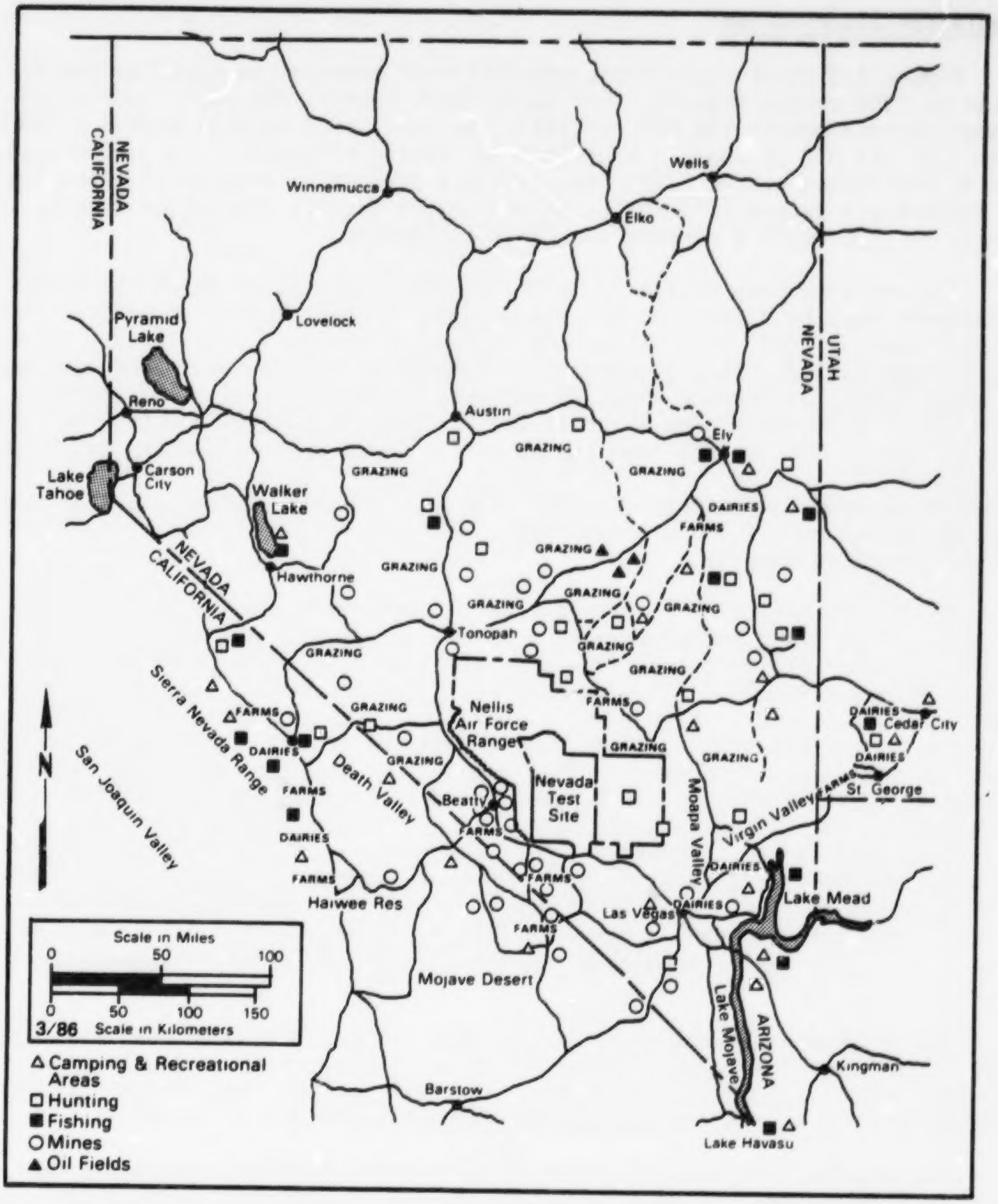
NEVADA
CALIFORNIA
UTAH
NEVADA
Winnemucca
Wells
Elko
Lovelock
Pyramid Lake
Reno
Austin
Ely
Lake Tahoe
Carson City
Walker Lake
Hawthorne
GRAZING
DAIRIES
FARMS
Tonopah
NEVADA
CALIFORNIA
Sierra Nevada Range
San Joaquin Valley
N
Nellis Air Force Range
Nevada Test Site
Death Valley
Beatty
Moapa Valley
Virgin Valley
Cedar City
St George
Haiwee Res
Las Vegas
Lake Mead
Mojave Desert
Lake Mojave
ARIZONA
Kingman
Barstow
Lake Havasu
Scale in Miles
0
50
100
0
50
100
150
3/86
Scale in Kilometers
△ Camping & Recreational Areas
□ Hunting
■ Fishing
○ Mines
▲ Oil Fields

Figure A-2. General land use within 300 km of the Nevada Test Site.

Population Distribution

Figure A-3 shows the current population of counties surrounding the NTS based on 1980 census figures. Excluding Clark County, the major population center (approximately 536,000 in 1984), the population density within a 150 km radius of the NTS is about 0.5 persons per square kilometer. For comparison, the 48 contiguous states (1980 census) had a population density of approximately 29 persons per square kilometer. The estimated average population density for Nevada in 1980 was 2.8 persons per square kilometer.

The off-site area within 80 km of the NTS (the area in which the dose commitment must be determined for the purpose of this report) is predominantly rural. Several small communities are located in the area, the largest being in the Pahrump Valley. This growing rural community, with an estimated population of about 5,500, is located about 72 km south of the NTS CP-1. The Amargosa Farm Area, which has a population of about 1,200, is located about 50 km southwest of CP-1. The largest town in the near-offsite area is Beatty, which has a population of about 900 and is located approximately 65 km to the west of CP-1. A report by Smith and Coogan was published in 1984 which summarizes the population distribution within selected rural areas out to 200 kilometers from the Control Point on the NTS.

The Mojave Desert of California, which includes Death Valley National Monument, lies along the southwestern border of Nevada. The National Park Service (NPS80) estimated that the population within the Monument boundaries ranges from a minimum of 200 permanent residents during the summer months to as many as 5,000 tourists and campers on any particular day during the major holiday periods in the winter months, and as many as 30,000 during "Death Valley Days" in the month of November. The largest town and contiguous populated area (about 40 square miles) in the Mojave Desert is Barstow, located 265 km south-southwest of the NTS, with a 1983 population of about 36,000. The next largest populated area is the Ridgecrest-China Lake area, which has a current population of about 25,000 and is located about 190 km southwest of the NTS. The Owens Valley, where numerous small towns are located, lies about 50 km west of Death Valley. The largest town in Owens Valley is Bishop, located 225 km west-northwest of the NTS, with a population of about 5,300 including contiguous populated areas.

The extreme southwestern region of Utah is more developed than the adjacent part of Nevada. The largest community is St. George, located 220 km east of the NTS, with a population of 11,300. The next largest town, Cedar City, with a population of 10,900, is located 280 km east northeast of the NTS.

The extreme northwestern region of Arizona is mostly range land except for that portion in the Lake Mead Recreation Area. In addition, several small communities lie along the Colorado River. The largest town in the area is Kingman, located 280 km southeast of the NTS, with a population of about 9,300. Figures A-4 through A-7 show the domestic animal populations in the counties near the NTS.

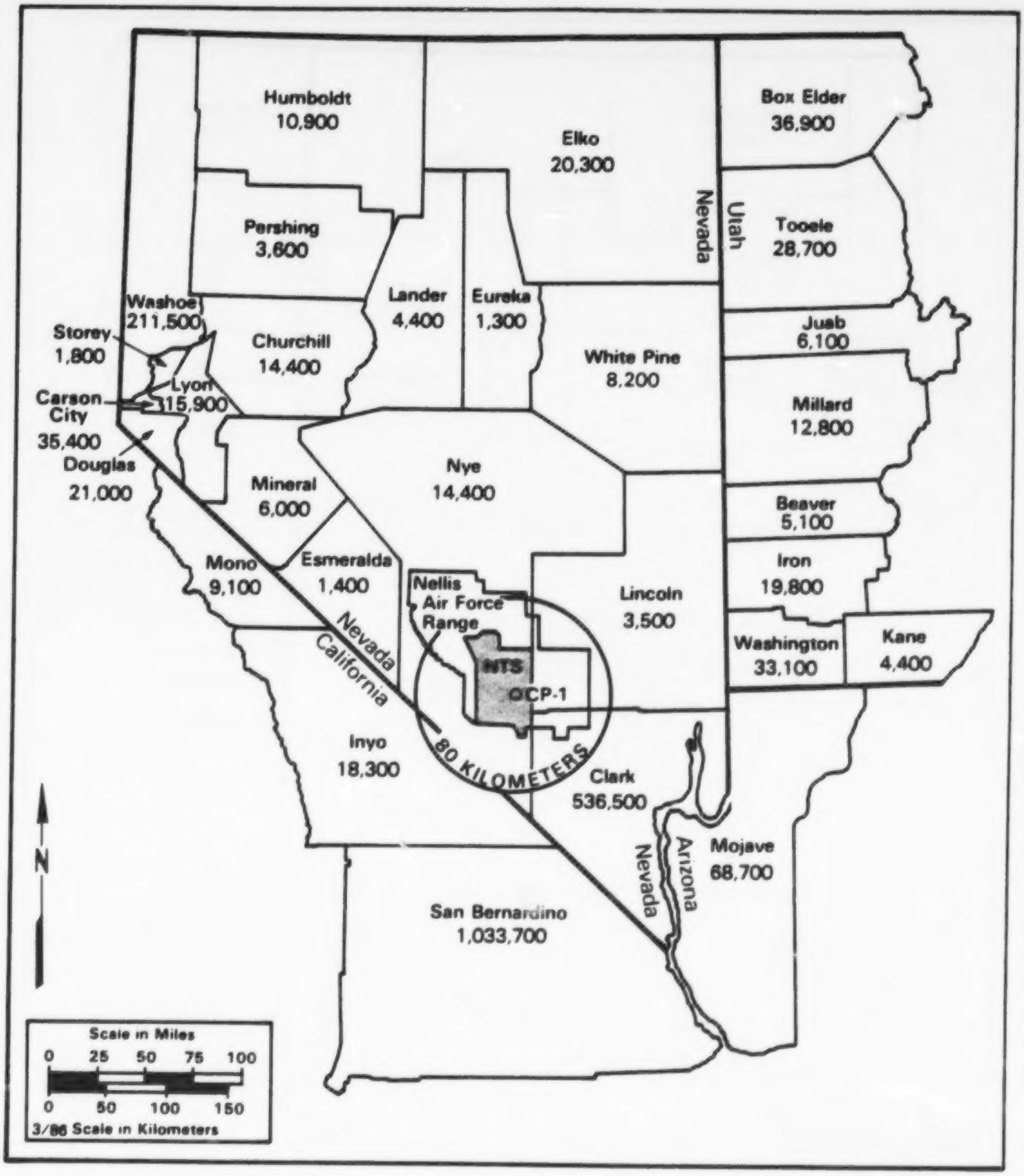
Humboldt
10,900
Elko
20,300
Box Elder
36,900
Pershing
3,600
Nevada
Utah
Tooele
28,700
Washoe
211,500
Lander
4,400
Eureka
1,300
Juab
6,100
Storey
1,800
Churchill
14,400
White Pine
8,200
Lyon
15,900
Carson City
35,400
Millard
12,800
Douglas
21,000
Nye
14,400
Mineral
6,000
Beaver
5,100
Mono
9,100
Esmeralda
1,400
Iron
19,800
Nellis Air Force Range
Lincoln
3,500
Washington
33,100
Kane
4,400
Nevada
California
NTS
OCP-1
Inyo
18,300
80 KILOMETERS
Clark
536,500
Nevada
Arizona
Mojave
68,700
N
San Bernardino
1,033,700
Scale in Miles
0
25
50
75
100
0
50
100
150
3/86 Scale in Kilometers

Figure A-3. Population of Arizona, California, Nevada, and Utah Counties near the Nevada Test Site (1980).

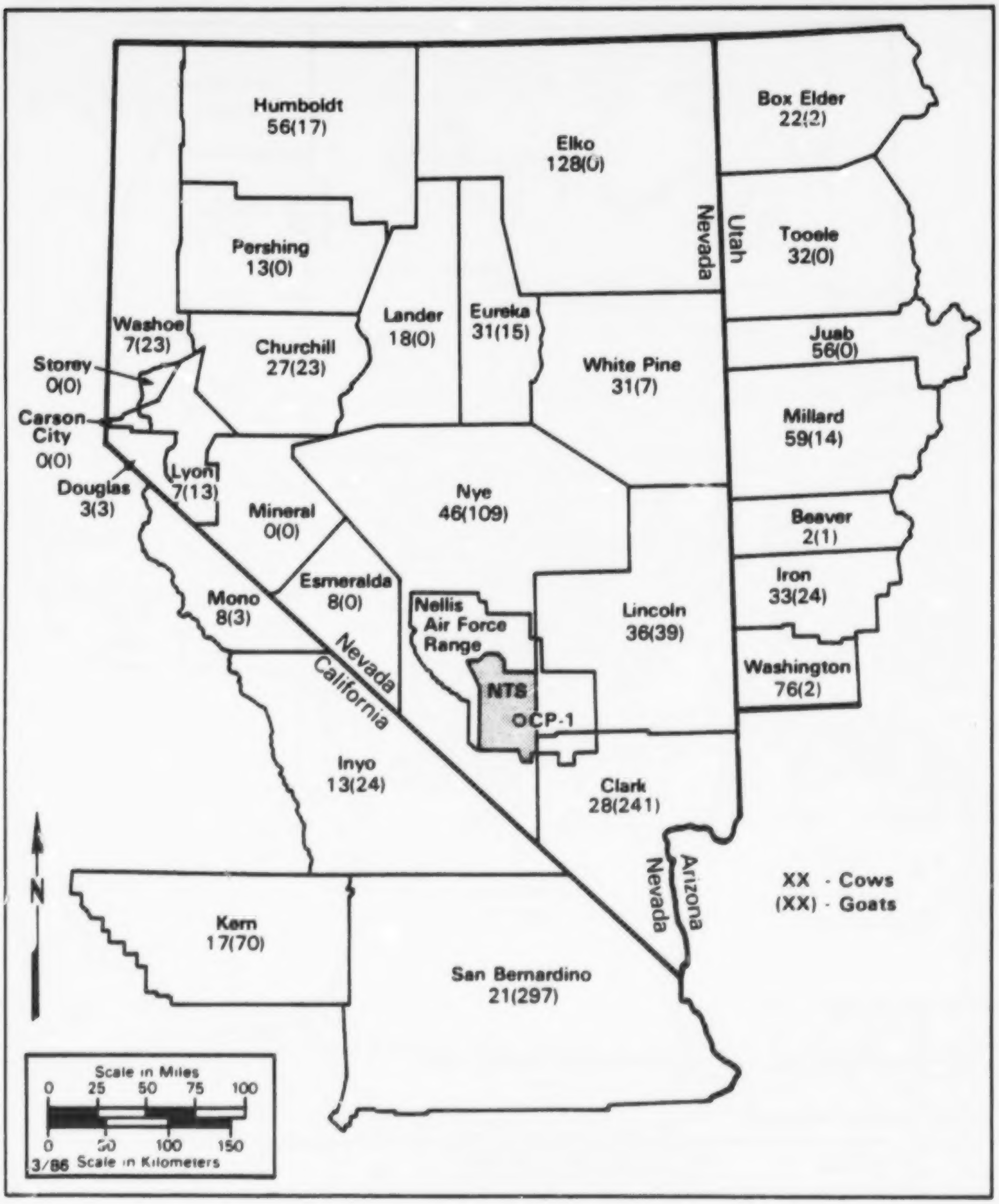
Humboldt 56(17)
Elko 128(0)
Box Elder 22(2)
Pershing 13(0)
Nevada
Utah
Tooele 32(0)
Washoe 7(23)
Churchill 27(23)
Lander 18(0)
Eureka 31(15)
Juab 56(0)
Storey 0(0)
White Pine 31(7)
Millard 59(14)
Carson City 0(0)
Douglas 3(3)
Lyon 7(13)
Mineral 0(0)
Nye 46(109)
Beaver 2(1)
Iron 33(24)
Mono 8(3)
Esmeralda 8(0)
Nellis Air Force Range
Lincoln 36(39)
Washington 76(2)
Nevada
California
NTS
OCP-1
Inyo 13(24)
Clark 28(241)
N
Arizona
Nevada
XX - Cows
(XX) - Goats
Kern 17(70)
San Bernardino 21(297)
Scale in Miles
0 25 50 75 100
0 50 100 150
3/86 Scale in Kilometers

Figure A-4. Distribution of family milk cows and goats, by county (1985).

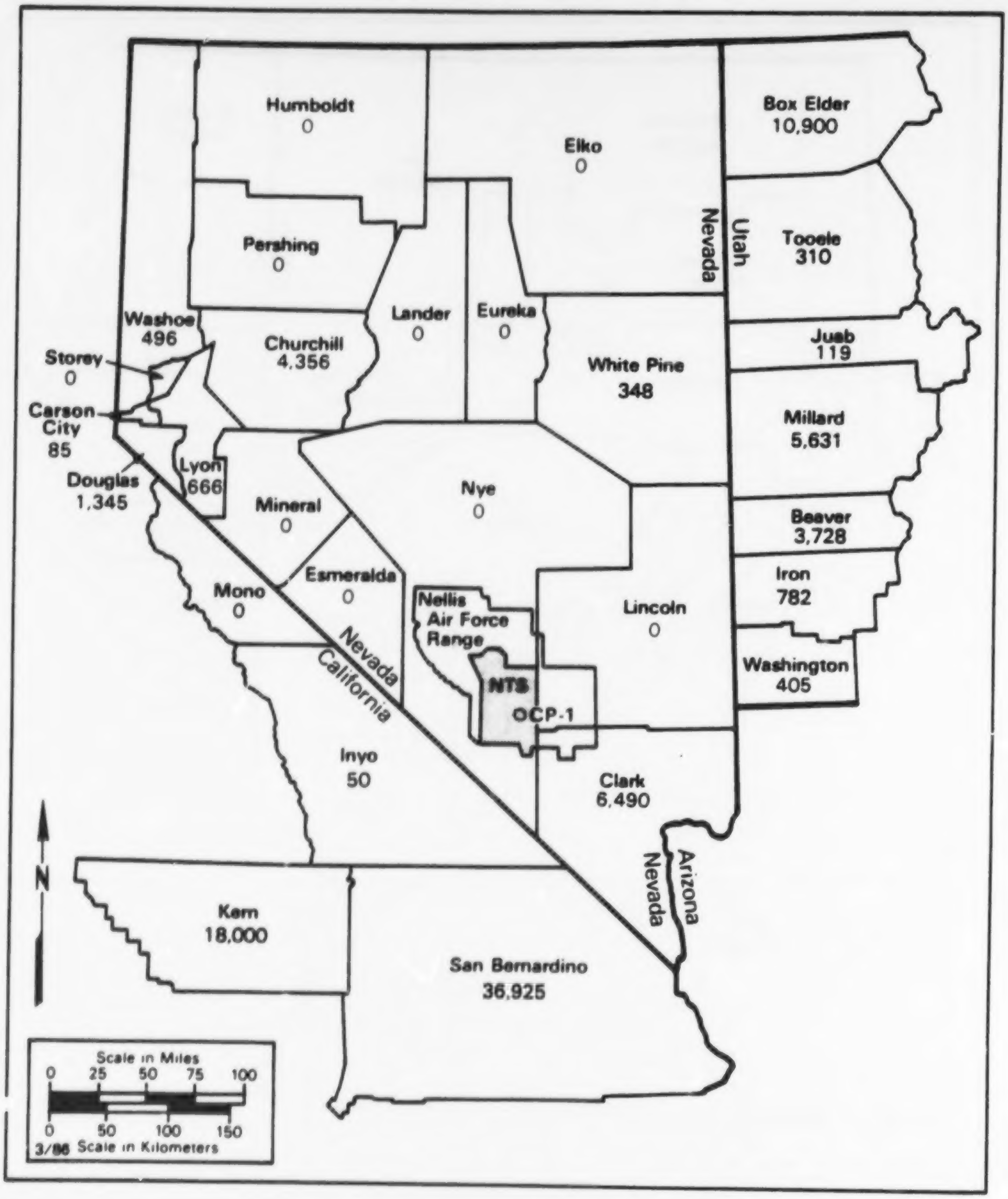
Humboldt
0
Elko
0
Box Elder
10,900
Pershing
0
Nevada
Utah
Tooele
310
Washoe
496
Churchill
4,356
Lander
0
Eureka
0
White Pine
348
Juab
119
Storey
0
Carson City
85
Millard
5,631
Douglas
1,345
Lyon
666
Mineral
0
Nye
0
Beaver
3,728
Esmeralda
0
Iron
782
Mono
0
Nellis Air Force Range
Lincoln
0
Nevada
California
Washington
405
NTS
OCP-1
Inyo
50
Clark
6,490
N
Arizona
Nevada
Kern
18,000
San Bernardino
36,925
Scale in Miles
0 25 50 75 100
0 50 100 150
3/86 Scale in Kilometers

Figure A-5. Distribution of dairy cows, by county (1985).

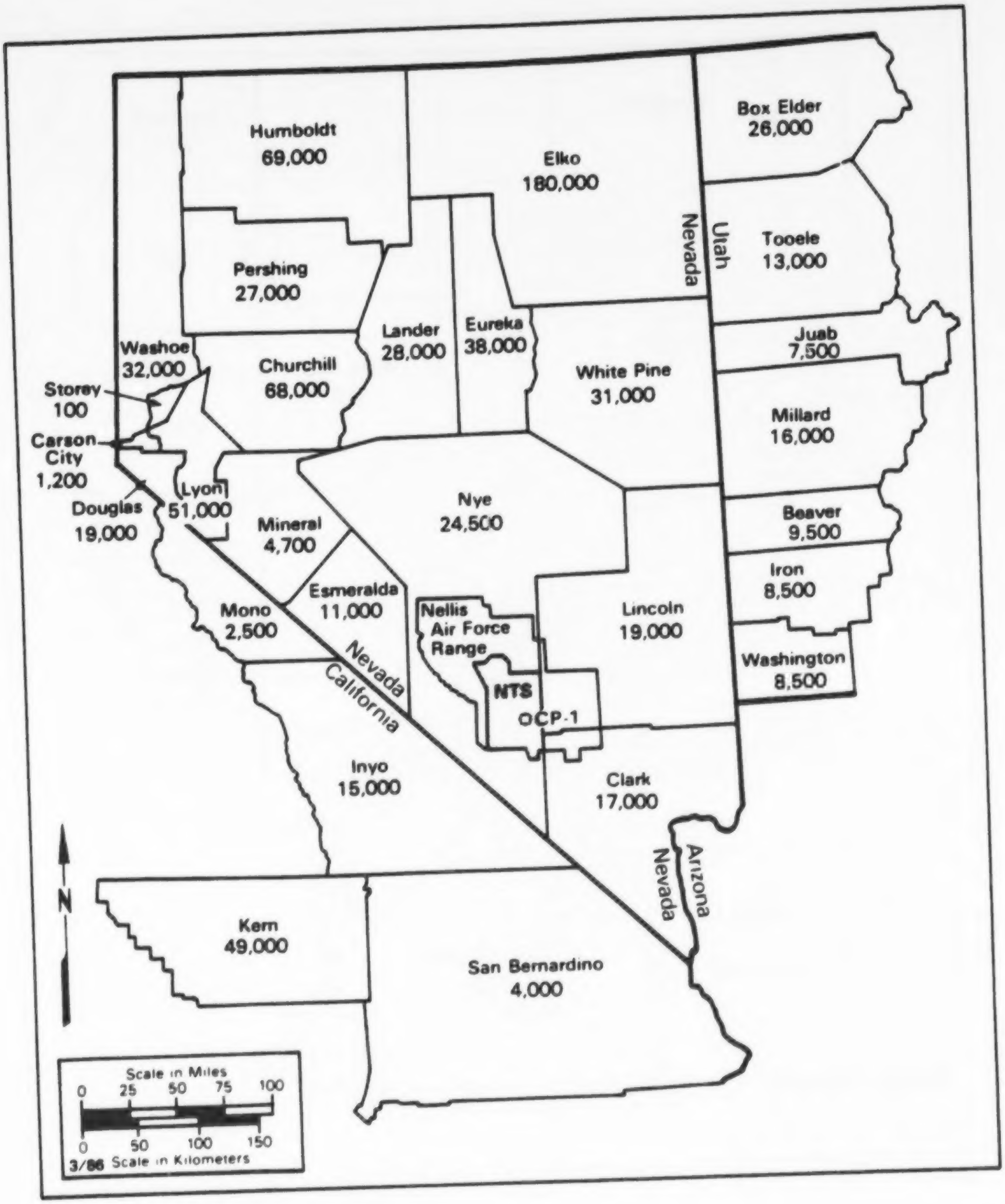
Humboldt
69,000
Elko
180,000
Box Elder
26,000
Pershing
27,000
Tooele
13,000
Nevada
Utah
Washoe
32,000
Churchill
68,000
Lander
28,000
Eureka
38,000
White Pine
31,000
Juab
7,500
Storey
100
Carson
City
1,200
Millard
16,000
Lyon
51,000
Douglas
19,000
Mineral
4,700
Nye
24,500
Beaver
9,500
Iron
8,500
Esmeralda
11,000
Mono
2,500
Nellis
Air Force
Range
Lincoln
19,000
Washington
8,500
NTS
OCP-1
Nevada
California
Inyo
15,000
Clark
17,000
Nevada
Arizona
N
Kern
49,000
San Bernardino
4,000
Scale in Miles
0
25
50
75
100
0
50
100
150
3/86
Scale in Kilometers

Figure A-6. Distribution of beef cattle, by county (1985).

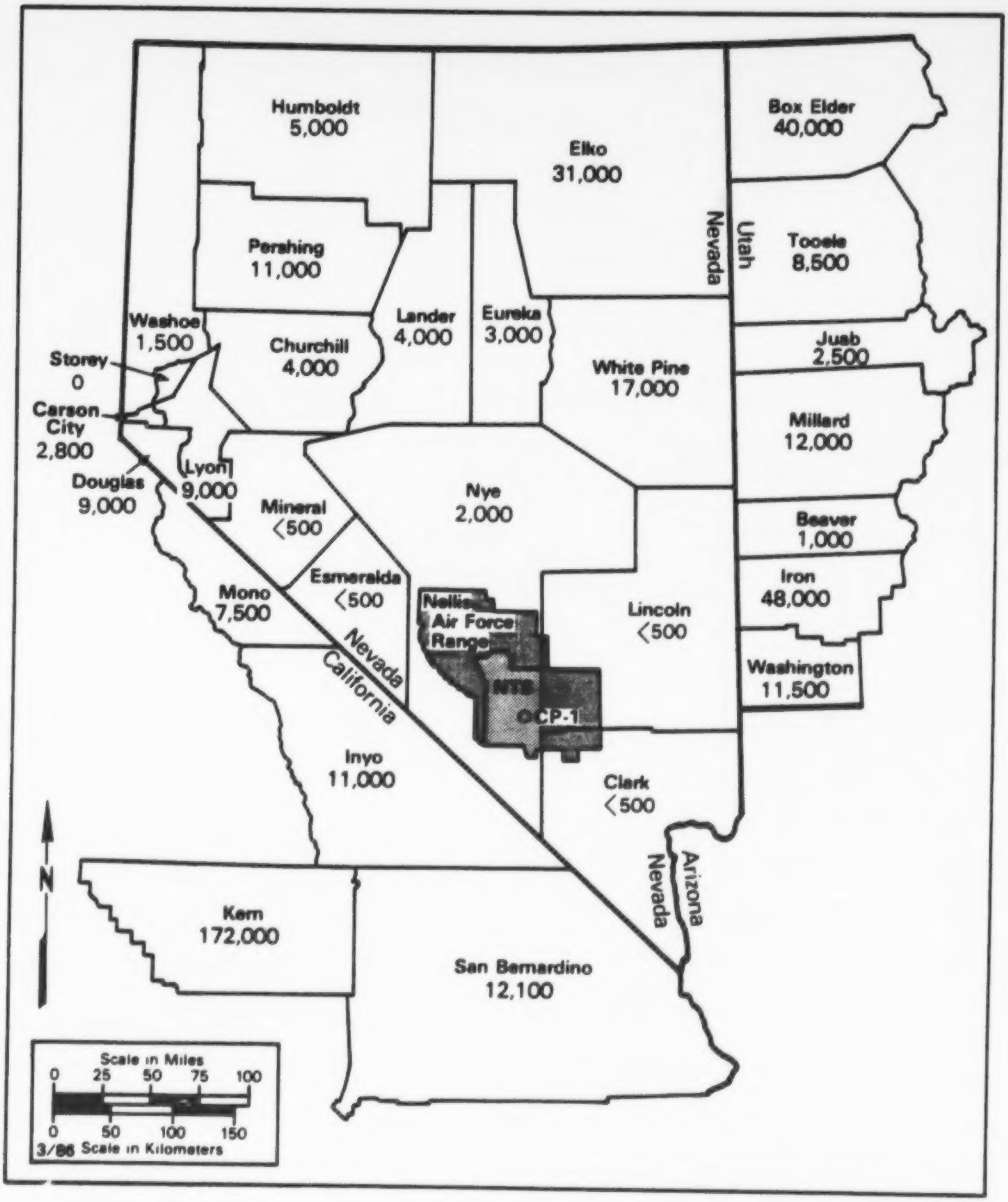
Humboldt
5,000
Elko
31,000
Box Elder
40,000
Pershing
11,000
Nevada
Utah
Tooele
8,500
Washoe
1,500
Churchill
4,000
Lander
4,000
Eureka
3,000
White Pine
17,000
Juab
2,500
Storey
0
Carson City
2,800
Millard
12,000
Douglas
9,000
Lyon
9,000
Mineral
<500
Nye
2,000
Beaver
1,000
Esmeralda
<500
Mono
7,500
Iron
48,000
Nellis Air Force Range
Lincoln
<500
Washington
11,500
Nevada
California
NTS
OCP-1
Inyo
11,000
Clark
<500
N
Nevada
Arizona
Kern
172,000
San Bernardino
12,100
Scale in Miles
0
25
50
75
100
0
50
100
150
3/86
Scale in Kilometers

Figure A-7. Distribution of sheep, by county (1985).

APPENDIX B

SAMPLE ANALYSIS PROCEDURES

APPENDIX B

SAMPLE ANALYSIS PROCEDURES

ANALYTICAL PROCEDURES

The procedures for analyzing samples collected for offsite surveillance are described by Johns et al. in "Radiochemical Analytical Procedures for Analyses of Environmental Samples" (EMSL-LV-0539-17, 1979) and are summarized in Table B-1.

TABLE B-1. SUMMARY OF ANALYTICAL PROCEDURES

Type of Analysis	Analytical Equipment	Counting Period (min)	Analytical Procedures	Sample Size	Approximate Detection Limit*
IG Ge(Li) Gamma Spectrometry**	IG or Ge(Li) detector calibrated at 0.5 keV/channel (0.04 to 2 MeV range) individual detector efficiencies ranging from 15% to 35%.	Air charcoal cartridges and individual air filters, 30 min; air filter composites, 1200 min. 100 min for milk, water, suspended solids.	Radionuclide concentration quantified from gamma spectral data by on-line computer program. Radionuclides in air filter composite samples are identified only.	120-300 m^3 for air filters; and charcoal cartridges; 3-1/2 liters for milk and water.	For routine milk and water generally, 5 pCi/L for most common fallout radionuclides in a simple spectrum. Filters for LTHMP suspended solids, 6 pCi/L. Air filters and charcoal cartridges, 0.04 pCi/m^3.
Gross beta on air filters	Low-level end window, gas flow proportional counter with a 12.7 cm diameter window (80 $\mu g/cm^2$)	30	Samples are counted after decay of naturally-occuring radionuclides and, if necessary, extrapolated to midpoint of collection in accordance with $t^{-1.2}$ decay or an experimentally-derived decay.	120-300 m^3	0.5 pCi/sample.

(continued)

TABLE B-1. (Continued)

Type of Analysis	Analytical Equipment	Counting Period (min)	Analytical Procedures	Sample Size	Approximate Detection Limit*
Sr-89-90	Low-background thin-window, gas-flow proportional counter.	50	Chemical separation by ion exchange. Separated sample counted successively; activity calculated by simultaneous solution of equations.	1.0 liter for milk or water. 0.1-1 kg for tissue.	Sr-89 = 5 pCi/L Sr-90 = 2 pCi/L.
H-3	Automatic liquid scintillation counter with output printer.	200	Sample prepared by distillation.	4 ml for water	400 pCi/L.
H-3 Enrichment (Long-Term Hydrological Samples)	Automatic scintillation counter with output printer.	200	Sample concentrated by electrolysis followed by distillation.	250 ml for water	10 pCi/L.
Pu-238,239	Alpha spectrometer with 450 mm, 300-μm depletion depth, silicon surface barrier detectors operated in vacuum chambers.	1000-1400	Water sample or acid-digested filter or tissue samples separated by ion exchange, electro-plated on stainless steel planchet.	1.0 liter for water; 0.1-1 kg for tissue; 5,000-10,000 m^3 for air.	Pu-238 = 0.08 pCi/L Pu-239 = 0.04 pCi/L for water. For tissue samples, 0.04 pCi per total sample for all isotopes; 5-10 aCi/m^3 for plutonium on air filters.
Kr-85, Xe-133, Xe-135	Automatic liquid scintillation counter with output printer.	200	Separation by gas chromatography; disolved in toluene "cocktail" for counting	0.4-1.0 m^3 for air	Kr-85, Xe-133, Xe-135 = 4 pCi/m^3.

*The detection limit is defined as 3.29 sigma where sigma equals the counting error of the sample and Type I error = Type II error = 5 percent. (J. P. Corley, D. H. Denham, R. E. Jaquish, D. E. Michels, A. R. Olsen, D. A. Waite, A Guide for Environmental Radiological Surveillance at U.S. Dept. of Energy Installations, July 1981, Office of Operational Safety Report DOE/EP-0023, U.S. DOE, Washington, D. C.)

**Gamma Spectrometry using either an intrinsic germanium (IG), or lithium-drifted germanium diode (Ge(Li)) detector.

APPENDIX C

QUALITY ASSURANCE PROCEDURES

PRECISION OF ANALYSIS

The duplicate sampling program was initiated for the purpose of routinely assessing the errors due to sampling, analysis, and counting of samples obtained from the surveillance networks maintained by the EMSL-LV.

The program consists of the analysis of duplicate or replicate samples from the ASN, the NGTSN, the LTHMP, and the Dosimetry Network. As the radioactivity concentration in samples collected from the LTHMP and the MSN are below detection levels, most duplicate samples for these networks are prepared from spiked solutions. The NGTSN samples are generally split for analysis.

At least 30 duplicate samples from each network are normally collected and analyzed over the report period. Since three TLD cards consisting of two TLD chips each are used at each station of the Dosimetry Network, no additional samples were necessary. Table C-1 summarizes the sampling information for each surveillance network.

To estimate the precision of a methodology, the standard deviation of replicate results is needed. Thus, for example, the variance, s^2, of each set

TABLE C-1. SAMPLES AND ANALYSES FOR DUPLICATE SAMPLING PROGRAM - 1985

Surveillance Network	Number of Sampling Locations	Samples Collected This Year	Sets of Duplicate Samples Collected	Number Per Set	Sample Analysis
ASN	114	5,146	309	2	Gross beta, γ Spectrometry
NGTSN	16	818 (NG) 866 (H3)	39 87	2	Kr-85, H-3, H_2O, HTO
Dosimetry	129	1,548	1,548	4-6	Effective dose from gamma
MSN	31	286	63	2	K-40, Sr-89, Sr-90, H-3
LTHMP	134	716	144	2	H-3

of replicate TLD results (n=6) was estimated from the results by the standard expression,

$$s^2 = \sum_{i=1}^{k} (x_i - \bar{x})^2 / (k - 1)$$

where k = number of sets of replicates.

Since duplicate samples were collected for all other sample types, the variances, s^2, for these types were calculated from $s^2 = (0.886R)^2$, where R is the absolute difference between the duplicate sample results. For small sample sizes, this estimate of the variance is statistically efficient* and certainly more convenient to calculate than the standard expression. The standard deviation is obtained by taking the square root.

The principle that the variances of random samples collected from a normal population follow a chi-square distribution (χ^2) was then used to estimate the expected population standard deviation for each type of sample analysis. The expression used is as follows:**

$$s = \left[\sum_{i=1}^{k} (n_i - 1) s_i^2 / \sum_{i=1}^{k} (n_i - 1) \right]^{1/2}$$

where n_i-1 = the degrees of freedom for n samples collected for the ith replicate sample

s_i^2 = the expected variance of the ith replicate sample

s = the best estimate of sample standard deviation derived from the variance estimates of all replicate samples (the expected value of s^2 is σ^2).

For expressing the precision of measurement in common units, the coefficient of variation ($s/\bar{x}$) was calculated for each sample type. These are displayed in Table C-2 for those analyses for which there were adequate data.

To estimate the precision of counting, approximately 10 percent of all samples are counted a second time. These are unknown to the analyst. Since all such replicate counting gave results within the counting error, the precision data in Table C-2 represents errors principally in analysis.

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*Snedecor, G. W., and W. G. Cochran. Statistical Methods. The Iowa State University Press, Ames, Iowa. 6th Ed. 1967. pp. 39-47.

**Freund, J. E. Mathematical Statistics. Prentice Hall, Englewood, New Jersey. 1962. pp 189-235.

TABLE C-2. SAMPLING AND ANALYTICAL PRECISION - 1985

Surveillance Network	Analysis	Sets of Replicate Samples Evaluated	Coefficient of Variation (%)
ASN	Gross β	40	97
	Be-7	4	13
NGTSN	Kr-85	38	12
	HTO	*	39
	H_2O	73	39
Dosimetry	TLD (1984)	344	4.1
MSN	K-40	61	11
	Sr-89	33	17
	Sr-90	38	17
LTHMP	H-3	36	5.2
	$H\text{-}3^+$	58	11

*Estimate of precision was calculated from the errors in the H-3 conventional analysis and the measurement of atmospheric moisture (H_2O).

ACCURACY OF ANALYSIS

Data from the analysis of intercomparison samples are statistically analyzed and compared to known values and values obtained from other participating laboratories. A summary of the statistical analysis is given in Table C-3, which compares the mean of three replicate analyses with the known value. The normalized deviation is a measure of the accuracy of the analysis when compared to the known concentration. The determination of this parameter is explained in detail separately (Ja81). If the value of this parameter (in multiples of standard normal deviate, unitless) lies between control limits of -3 and +3, the precision or accuracy of the analysis is within normal statistical variation. However, if the parameters exceed these limits, one must suspect that there is some cause other than normal statistical variations that contributed to the difference between the measured values and the known value. As shown by this table, all but one of the analyses were within the control limit.

The analytical methods were further checked on by Laboratory participation in the semiannual Department of Energy Quality Assessment Program conducted by the Environmental Measurements Laboratory, New York, N.Y. and in the intercomparison studies conducted by the World Health Organizations International Reference Center for Radioactivity located in France. The results from both of these tests (Table C-4) indicate that this Laboratory's results were of acceptable quality.

TABLE C-3. EPA QUALITY ASSURANCE INTERCOMPARISON RESULTS - 1985

Analysis	Month	Mean of Replicate Analyses (pCi/L)	Known Value (pCi/L)	Normalized Deviation from: Known Conc.
H-3 in water	Feb	4083	3796	1.4
	Apr	3826	3559	1.3
	Jun	2341	2416	-0.4
	Aug	4402	4480	-0.3
	Oct	2072	1974	0.5
H-3 in urine	Apr	3119	3056	0.3
	Jul	2515	2444	0.4
	Nov	3548	3586	-0.2
Cr-51 in water	Feb	50	48	0.7
Co-60 in water	Feb	19	20	-0.3
	Apr	16	15	0.3
Zn-65 in water	Feb	57	55	0.6
Ru-106 in water	Feb	<30	25	-
I-131 in water	Apr	7.5	7.5	0
Cs-134 in water	Feb	33	35	-0.8
	Apr	15	15	-0.2
Cs-137 in water	Feb	24	25	-0.2
	Apr	13	15	-0.7
Sr-89 in milk	June	12	11	0.3
	Oct	50	50	0
Sr-90 in milk	June	11	11	0
	Oct	23	28	-5.4
I-131 in milk	Feb	9	9	-0.4
	Oct	41	42	-0.2
Cs-137 in milk	June	10	11	-0.2
	Oct	57	56	0.3

(continued)

TABLE C-3. (Continued)

Analysis	Month	Mean of Replicate Analyses (pCi/L)	Known Value (pCi/L)	Normalized Deviation from: Known Conc.
K in Milk (mg/l)	Jun	1512	1525	-0.3
	Oct	1513	1540	-0.6
Cs-137 in air filter (pCi/filter)	Mar	6	6	0.1

To measure the performance of the contractor laboratory for analysis of animal tissues, a known amount of activity was added to several samples. The reported activity is compared to the known amount in Table C-5. The average bias for Sr-90 was -37 percent and for Pu-239 was -13 percent. The precision was 9% for both analyses.

In addition to calibration of the TLD's with a Cs-137 source traceable to NBS, the accuracy of the results obtained from the Dosimetry Network is affirmed by participation in the International Intercomparison of Environmental Dosimeters Program operated by the Idaho Operations Office of the DOE. The eighth such intercomparison study is presently nearing completion.

For personal dosimeters, this Laboratory was accredited in 1985 under the National Voluntary Laboratory Accreditation Program operated by the National Bureau of Standards. For both personal and environmental dosimeters, the TLD measurements are performed according to standards proposed by the American National Standards Institute (ANSI75).

TABLE C-4. QUALITY ASSURANCE RESULTS FROM OTHER ORGANIZATIONS

Analysis	Month	EMSL-LV Results	EML Results	Ratio EMSL-LV/EML	Units
Environmental Measurements Laboratory, DOE					
H-3 in water	May	19.1	18.5	1.03	pCi/ml
	Nov	19.3	19.5	0.99	pCi/ml
Mn-54 in water	May	3.50	3.42	1.02	pCi/ml
	Nov	4.50	4.43	1.02	pCi/ml
Fe-59 in water	Nov	0.453	0.453	1.00	pCi/ml
Co-60 in water	May	5.09	4.91	1.04	pCi/ml
	Nov	4.80	4.82	1.00	pCi/ml
Sr-90 in water	May	1.05	1.02	1.03	pCi/ml
	Nov	0.415	0.440	0.94	pCi/ml
Cs-137 in water	May	5.49	5.36	1.02	pCi/ml
	Nov	4.62	4.62	1.00	pCi/ml
Ce-141 in water	Nov	4.30	4.45	0.97	pCi/ml
Ce-144 in water	May	42.9	40.6	1.06	pCi/ml
Pu-239 in water	May	0.0349	0.0428	0.82	pCi/ml
	Nov	0.0248	0.0400	0.62	pCi/ml
Pu-239 in air filter No. 1	May	4.67	4.81	0.97	pCi/filter
	Nov	5.34	4.91	1.09	pCi/filter
Pu-239 in air filter No. 2	May	5.32	4.81	1.11	pCi/filter
K-40 in soil	May	22.2	20.3	1.09	pCi/g
	Nov	21.2	19.4	1.09	pCi/g
Cs-137 in soil	May	0.849	0.760	1.12	pCi/g
	Nov	0.290	0.270	1.07	pCi/g
Pu-239 in soil	May	0.0445	0.0350	1.27	pCi/g
	Nov	0.277	0.240	1.15	pCi/g

(continued)

TABLE C-4. (Continued)

Analysis	Month	EMSL-LV Results	EML Results	Ratio EMSL-LV/EML	Units
K-40 in tissue	May	9.69	3.86	2.51*	pCi/g
	Nov	4.01	1.76	2.28*	pCi/g
Co-60 in tissue	May	0.584	0.360	1.62*	pCi/g
Cs-137 in tissue	May	1.41	0.810	1.74*	pCi/g
	Nov	0.882	0.440	2.00*	pCi/g
Pu-239 in tissue	May	0.0117	0.0081	1.44	pCi/g
	Nov	0.423	0.410	1.03	pCi/g
International Reference Center for Radioactivity, WHO					
H-3 in milk	Jan	111	89	1.25	Bq/L
K-40 in milk	Jan	1.57	1.58	0.99	g/L
Ce-137 in milk	Jan	0.66	0.68	0.97	Bq/L

*These were ashed samples. The EMSL-LV system is calibrated for homogenized fresh tissue so the results are expected to be high.

TABLE C-5. QUALITY ASSURANCE RESULTS FOR THE BIOENVIRONMENTAL PROGRAM - 1985

Sample Type and Shipment Number	Nuclide	Activity Added pCi/g Bone Ash	Activity Reported pCi/g Bone Ash	% Bias+ or Precision‡
		Spiked Samples		
Bone Ash				
Ash A	239Pu	0	0.002**	-
60	90Sr	0	1.2	-
Ash B	239Pu	0	0.001**	-
60	90Sr	0	1.5	-
Ash 11	239Pu	0.15	0.15	-1
60	90Sr	29.4	-21.4	-32
Ash 12	239Pu	0.114	0.11	-5
60	90Sr	13.8	10.2	-36
Ash 25	239Pu	0	-0.002**	-
62	90Sr	0	1.5	-
Ash 26	239Pu	0	0.002**	-
62	90Sr	0	1.2	-
Ash 27	239Pu	0.14	0.12	-15
62	90Sr	22.9	19.9	-19
Ash 28	239Pu	0.12	0.10	-18
62	90Sr	17.5	14.4	-25
Ash C	239Pu	0.16	0.13	-20
65	90Sr	13.6	9.2	-42
Ash D	239Pu	0.18	0.14	-23
65	90Sr	10.8	7.5	-43
Duplicate Samples				
Bov-4	239Pu		-0.001	0.09
	90Sr		1.9	
Bov-4 Dup	239Pu		0.0009	0.09
	90Sr		2.1	

+ Bias (B) = Recovery -1; where recovery is $\frac{x_1}{u}$

and x_1 = net activity reported
u = activity added

$$\ddagger \text{ Precision } (C_v) = 2\left(\frac{x_1 - x_2}{x_1 + x_2}\right) \times \frac{1}{1.128}$$

where x_1 = first value
x_2 = second value

**Counting error exceeds reported activity

APPENDIX C

QUALITY ASSURANCE PROCEDURES

APPENDIX D

RADIATION PROTECTION STANDARDS FOR EXTERNAL AND INTERNAL EXPOSURE

APPENDIX D

RADIATION PROTECTION STANDARDS FOR EXTERNAL AND INTERNAL EXPOSURE

DOE EQUIVALENT COMMITMENT

For stochastic effects in members of the public, the following limits are used:

	Effective Dose Equivalent*	
	mrem/yr	mSv/yr
Occasional annual exposures**	500	5
Prolonged period of exposure	100	1

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*Includes both effective dose equivalent from external radiation and committed effective dose equivalent from ingested and inhaled radionuclides.

**Occasional exposure implies exposure over a few years with the proviso that over a lifetime the average exposure does not exceed 100 mrem (1 mSv) per year (ICRP-39).

CONCENTRATION GUIDES

ICRP-30 lists Derived Air Concentrations (DAC) and Annual Limits of Intake (ALI). The ALI is the secondary limit and can be used with assumed breathing rates and ingested volumes to calculate concentration guides. The concentration guides (CG's) in Table D-1 were derived in this manner and yield the committed effective dose equivalent (50 year) of 100 mrem/yr for members of the public.

EPA DRINKING WATER GUIDE

In 40 CFR 141 the EPA set allowable concentrations for continuous controlled releases of radionuclides to drinking water sources. Any single or combination of beta and gamma emitters should not lead to exposures exceeding 4 mrem/yr. For tritium this is 20,000 pCi/L (740 Bq/L) and for strontium is 8 pCi/L (0.3 Bq/L).

TABLE D-1. ROUTINE MONITORING FREQUENCY, SAMPLE SIZE, MDC AND CONCENTRATION GUIDES

Nuclide	Sampling Frequency	Locations	Sample Size	Count Time	Concentration Guide*		MDC	MDC as % CG
Air Surveillance Network			m^3	minutes	Bq/m^3	nCi/m^3	mBq/m^3	
Be-7	3/wk	all	160-240	30	2000	50	17	8E-4
Zr-95	3/wk	all	160-240	30	20	0.6	4.1	2E-2
Nb-95	3/wk	all	160-240	30	100	3	1.8	2E-3
Mo-99	3/wk	all	160-240	30	100	3	1.5	2E-3
Ru-103	3/wk	all	160-240	30	60	2	1.8	3E-3
I-131	3/wk	all	160-240	30	4	0.1	1.8	4E-2
Te-132	3/wk	all	160-240	30	18	0.5	1.8	1E-2
Cs-137	3/wk	all	160-240	30	10	0.4	1.8	2E-2
Ba-140	3/wk	all	160-240	30	100	3	4.8	5E-3
La-140	3/wk	all	160-240	30	100	3	2.6	3E-3
Ce-141	3/wk	all	160-240	30	50	1	3.0	6E-3
Ce-144	3/wk	all	160-240	30	1	0.03	12	1.2
Pu-239	3/wk	all	1120	1000	9E-4	2E-5	1.48E-3	2E-1
Gross Beta	3/wk	all	160-240	30	2E-2	0.4E-4	0.11	6E-1

(continued)

TABLE D-1. Continued

Nuclide	Sampling Frequency	Locations	Sample Size	Count Time	Concentration Guide*		MDC	MDC as % CG
Noble Gas	Tritium in Air		m^3	Minutes	Bq/m^3	nCi/m^3	mBq/m^3	
H-3	1/wk	17	5	200	7000	190	148	2E-3
Kr-85	1/wk	17	0.4	200	2E5	6000	148	7E-5
Xe-133	1/wk	17	0.4	200	2E4	480	148	7E-4
Xe-135	1/wk	17	0.4	200	2E3	60	148	7E-3
Water Surveillance Network (LTHMP)			Liters	Minutes	Bq/L	pCi/L	Bq/L	
H-3	1/mo	all	1	200	7E2	2E4	12	1.7
H-3 (Enrich)	1/mo	all	0.1	200	7E2	2E4	0.37	5E-2
Sr-89	1st time	all	1	50	600	2E4	0.18	0.03
Sr-90	1st time	all	1	50	0.3	8	0.074	25
Cs-137	1/mo	all	1	100	160	3E3	0.33	0.3
Ra-226	1st time	all	1	1000	5	100	NA	
U-234	1st time	all	1	1000	20	500	NA	
U-235	1st time	all	1	1000	20	600	NA	
U-238	1st time	all	1	1000	20	600	NA	
Pu-238	1st time	all	1	1000	10	400	0.003	0.03

(continued)

TABLE D-1. Continued

Nuclide	Sampling Frequency	Locations	Sample Size	Count Time	Concentration Guide*		MDC	MDC as % CG
Water Surveillance Network (LTHMP)			Liters	Minutes	Bq/L	pCi/L	Bq/L	
Pu-239	1st time	all	1	1000	10	300	0.002	0.02
Gamma	1/mo	all	3.5	30	--	--	0.18	<0.2
Milk Surveillance Network								
H-3	1/mo	all	3.5	200	8E4	2E6	12	2E-2
Cs-137	1/mo	all	3.5	100	100	3E3	0.33	0.3
Sr-89	1/mo	all	3.5	50	600	2E4	0.18	3E-2
Sr-90	1/mo	all	3.5	50	40	1E3	0.074	0.2
Gamma	1/mo	all	3.5	50	--	--	0.18	<0.2
Dosimetry Network			Number		Exposure Guide		MDA	
TLD (Personnel)	1/mo	50	2	--	100mR		2mR	2
TLD (Station)	1/qtr	130	6	--	--		2mR	--
Ion Chamber	weekly	23	2016	--	--		2μR/hr	--

Na - Not Available

*ALI and DAC values from ICRP-30 modified to 1 mSv annual effective dose equivalent for continuous exposure. Te and I data corrected to 2 g thyroid, greater milk intake, and smaller volume of air breathed annually (1 year-old infant).

APPENDIX E

DATA SUMMARY FOR THE MONITORING NETWORKS

TABLE E-1. SUMMARY OF ANALYTICAL RESULTS FOR AIR SURVEILLANCE NETWORK CONTINUOUSLY OPERATING STATIONS - 1985

SAMPLING LOCATION	NO. DAYS DETECTED /SAMPLED	RADIO-NUCLIDE	RADIOACTIVITY CONC. (PCI/M3)		
			MAX	MIN	AVG*
DEATH VALLEY JCT CA	35.3/352.2	7BE	0.79	0.24	0.043
FURNACE CREEK CA	67.1/355.3	7BE	0.70	0.16	0.058
SHOSHONE CA	61.4/346.9	7BE	0.45	0.23	0.055
ALAMO NV	15.0/364.0	7BE	0.46	0.33	0.016
AUSTIN NV	26.4/360.8	7BE	0.64	0.42	0.038
BEATTY NV	21.4/360.2	7BE	0.80	0.32	0.027
STONE CABIN RANCH NV	4.8/341.9	7BE	0.78	0.34	0.0072
CURRANT NV - BLUE EAGLE RANCH	16.0/348.7	7BE	0.87	0.34	0.023
ELY NV	3.0/358.8	7BE	0.48	0.48	0.0040
GOLDFIELD NV	26.3/359.4	7BE	0.70	0.40	0.042
GROOM LAKE NV	34.0/352.3	7BE	0.89	0.24	0.037
HIKO NV	20.0/364.2	7BE	0.60	0.38	0.026
INDIAN SPRINGS NV	38.3/362.5	7BE	0.69	0.33	0.051
LAS VEGAS NV	19.4/376.9	7BE	0.72	0.26	0.024
LATHROP WELLS NV	34.6/361.7	7BE	0.67	0.30	0.039
NYALA NV	26.0/354.9	7BE	0.79	0.29	0.033

(continued)

TABLE E-1. Continued

SAMPLING LOCATION	NO. DAYS DETECTED /SAMPLED	RADIO-NUCLIDE	RADIOACTIVITY CONC. (PCI/M3) MAX	MIN	AVG*
OVERTON NV	24.3/362.7	7BE	0.89	0.35	0.036
PAHRUMP NV	17.1/347.2	7BE	0.65	0.42	0.026
PIOCHE NV	17.2/232.4	7BE	1.4	0.37	0.043
SCOTTY'S JCT NV	9.0/365.0	7BE	0.51	0.27	0.0090
SUNNYSIDE NV	24.9/351.7	7BE	0.67	0.33	0.031
RACHEL NV - ROBINSON TRAILER P	25.3/364.1	7BE	0.57	0.29	0.027
TONOPAH NV	18.0/359.0	7BE	1.1	0.46	0.032
TTR NV	149.2/335.9	7BE	0.76	0.15	0.15
FALLINI'S (TWIN SPGS) RANCH NV	6.0/353.8	7BE	0.36	0.24	0.0051
CEDAR CITY UT	35.5/355.1	7BE	0.63	0.24	0.037
DELTA UT	11.5/181.0	7BE	0.65	0.34	0.031
MILFORD UT	17.2/360.5	7BE	0.89	0.35	0.027
ST GEORGE UT	19.0/365.9	7BE	0.50	0.35	0.022
SALT LAKE CITY UT	104.3/339.2	7BE	0.67	0.16	0.11

*AVG MEANS TIME-WEIGHTED AVERAGE OVER SAMPLING TIME.

TABLE E-2. SUMMARY OF ANALYTICAL RESULTS FOR AIR SURVEILLANCE NETWORK STANDBY STATIONS OPERATED 1 OR 2 WEEKS PER QUARTER - 1985

SAMPLING LOCATION	NO. DAYS DETECTED /SAMPLED	RADIO-NUCLIDE	RADIOACTIVITY CONC. (PCI/M3)		
			MAX	MIN	AVG
KINGMAN AZ	2.0/22.1	7BE	0.63	0.63	0.058
LITTLE ROCK AR	6.8/34.2	7BE	0.66	0.33	0.085
ALTURAS CA	5.3/28.2	7BE	0.51	0.28	0.068
BAKER CA	3.5/26.0	7BE	0.41	0.41	0.055
RIDGECREST CA	3.1/26.7	7BE	0.47	0.47	0.054
GRAND JUNCTION CO	7.3/37.4	7BE	0.65	0.29	0.086
NAMPA ID	3.0/37.0	7BE	0.49	0.49	0.039
IOWA CITY IA	4.8/46.0	7BE	0.21	0.21	0.021
DODGE CITY KS	3.0/40.0	7BE	0.42	0.42	0.031
GREAT FALLS MT	3.0/27.9	7BE	0.56	0.56	0.061
KALISPELL MT	7.0/41.9	7BE	0.19	0.19	0.032
CALIENTE NV	3.1/32.9	7BE	0.42	0.42	0.040
CURRIE NV	10.4/45.5	7BE	0.33	0.33	0.076
ELKO NV	5.0/29.2	7BE	0.51	0.40	0.075
FALLON NV	3.0/26.4	7BE	0.33	0.33	0.037
ALBUQUERQUE NM	2.1/29.0	7BE	0.65	0.65	0.047
SHIPROCK NM	5.0/17.9	7BE	0.62	0.42	0.14
WILLISTON ND	6.9/32.8	7BE	0.16	0.16	0.034
RAPID CITY SD	2.0/27.9	7BE	0.73	0.73	0.052
LOGAN UT	3.1/28.2	7BE	0.25	0.25	0.028
PAROWAN UT	6.8/35.9	7BE	0.32	0.32	0.060

(continued)

TABLE E-2. Continued

SAMPLING LOCATION	NO. DAYS DETECTED /SAMPLED	RADIO- NUCLIDE	RADIOACTIVITY CONC. (PCI/M3)		
			MAX	MIN	AVG
WENDOVER UT	5.0/26.8	7BE	0.82	0.20	0.084
SPOKANE WA	3.0/28.1	7BE	0.37	0.37	0.040

THE FOLLOWING STATIONS HAD NEGLIGIBLE GAMMA-SPECTRA:

GLOBE AZ
TUCSON AZ
WINSLOW AZ
YUMA AZ
BISHOP CA
CHICO CA
INDIO CA
LONE PINE CA
NEEDLES CA
SANTA ROSA CA
CORTEZ CO
DENVER CO
MOUNTAIN HOME ID
POCATELLO ID
FORT DODGE IA
MONROE LA
MINNEAPOLIS MN
CLAYTON MO
JOPLIN MO
ST JOSEPH MO
MILES CITY MT
NORTH PLATTE NE
ADAVEN (CANFIELD'S RANCH) NV
BATTLE MOUNTAIN NV
BLUE JAY NV
CURRANT NV - ANGLE WORM RANCH
DUCKWATER NV
EUREKA NV
FRENCHMAN STATION NV
GEYSER RANCH NV
LOVELOCK NV
LUND NV
MESQUITE NV
RENO NV
ROUND MOUNTAIN NV
WELLS NV
WINNEMUCCA NV
CARLSBAD NM
BISMARK ND
FARGO ND
MUSKOGEE OK
MEDFORD OR
BURNS OR
AMARILLO TX
AUSTIN TX
MIDLAND TX
TYLER TX
BRYCE CANYON UT
ENTERPRISE UT
GARRISON UT
VERNAL UT
SEATTLE WA
ROCK SPRINGS WY
WORLAND WY

TABLE E-3. SUMMARY OF GROSS BETA ANALYSES FOR AIR SURVEILLANCE NETWORK - 1985

SAMPLING LOCATION	NO. DAYS SAMPLED	RADIOACTIVITY CONC. (PCI/M3)		
		MAX	MIN	AVG
SHOSHONE CA	346.9	0.14	-0.0022	0.016
LAS VEGAS NV	375.0	0.17	0.0017	0.015
DELTA UT	181.0	0.10	0.00045	0.015
MILFORD UT	357.5	0.19	0.0016	0.018
ST GEORGE UT	363.9	0.084	0.00075	0.016

TABLE E-4. PLUTONIUM-239 CONCENTRATION IN COMPOSITED AIR SAMPLES* - 1985

SAMPLING LOCATION	FIRST QUARTER	SECOND QUARTER	THIRD QUARTER	FOURTH QUARTER	ANNUAL AVERAGE
WINSLOW/TUCSON, AZ	11.5	-13.6	17.8	0.00117	3.9
BISHOP/RIDGECREST, CA	-9.79	-38.0	-14.4	-4.76	-14
DENVER AND CORTEZ, CO	-18.5	-6.45	-2.94	-10.3	-8.4
MT HOME/NAMPA, ID	-11.8	-7.73	-18.9	-8.76	-13
JOPLIN/CLAYTON, MO	-11.9	-19.7	-15.8	-4.49	-13
GREAT FALLS/MILES CITY, MT	-14.7	0.0	-9.06	0.0	-8.1
LAS VEGAS, NV	-3.5	1.0	2.7	-6.0	-0.68
LATHROP WELLS, NV	-1.8	0.16	-12	3.7	-2.8
RACHEL, NV	-8.3	-1.8	-10	-4.7	-5.8
BISMARCK/FARGO, ND	-2.01	0.0	-3.72	-22.9	-
ALBUQUERQUE/CARLSBAD, NM	-6.64	-	-	-	-6.64
MEDFORD/BURNS, OR	-10.4	-10.2	-11.8	0.0	-8.5
AUSTIN/AMARILLO, TX	-9.92	-14.8	0.0	-4.23	-5.2
VERNAL/LOGAN, UT	-	-20	-9.0	-9.2	-12
SALT LAKE CITY, UT	-0.32	-0.88	-26	-3.1	-8.1
SEATTLE/SPOKANE, WA	-3.61	-17.0	-9.78	7.20	-3.5
WORLAND/ROCK SPRINGS, WY	-13.4	0.0	0.0	--	-3.6

*ALL DATA ARE EXPRESSED IN ACI/M^3 AND ARE LESS THAN THE MDC WHICH VARIED FROM 10 TO 100 ACI/M^3. ALL PLUTONIUM-238 RESULTS WERE ALSO LESS THAN MDC.

TABLE E-5. SUMMARY OF ANALYTICAL RESULTS FOR THE NOBLE GAS AND TRITIUM SURVEILLANCE NETWORK - 1985

SAMPLING LOCATION	NUMBER SAMPLES POSITIVE/ NEGATIVE	RADIONUCLIDE	RADIOACTIVITY CONC. (PCI/M3)*			PERCENT CONC. GUIDE+
			MAX	MIN	AVG	
SHOSHONE CA	48/4	85KR	46	22	29	0.03
	46/6	133XE	18	-7.2	4.5	<0.01
	51/0	3H IN ATM. M.*	0.56	-0.29	0.097	-
	51/0	3H AS HTO IN AIR	4.5	-1.3	0.78	<0.01
ALAMO NV	46/6	85KR	36	20	29	0.03
	44/8	133XE	58	-2.1	9.1	<0.01
	53/0	3H IN ATM. M.*	0.52	-0.30	0.039	-
	53/0	3H AS HTO IN AIR	3.4	-3.4	0.21	<0.01
AUSTIN NV	41/11	85KR	35	24	30	0.03
	40/12	133XE	19	-31	4.2	<0.01
	53/0	3H IN ATM. M.*	0.42	-0.32	0.020	-
	53/0	3H AS HTO IN AIR	2.6	-2.3	0.13	<0.01
BEATTY NV	38/15	85KR	36	24	30	0.03
	38/15	133XE	47	-25	6.5	<0.01
	53/0	3H IN ATM. M.*	0.33	-0.32	0.045	-
	53/0	3H AS HTO IN AIR	1.9	-1.5	0.27	<0.01
ELY NV	47/6	85KR	37	22	29	0.03
	44/9	133XE	48	-14	6.9	<0.01
	53/0	3H IN ATM. M.*	0.43	-0.42	0.047	-
	53/0	3H AS HTO IN AIR	3.8	-2.3	0.29	<0.01
GOLDFIELD NV	46/6	85KR	61	24	30	0.03
	42/10	133XE	30	-5.8	6.6	<0.01
	52/0	3H IN ATM. M.*	0.53	-0.31	0.056	-
	52/0	3H AS HTO IN AIR	4.7	-3.4	0.26	<0.01
INDIAN SPRINGS N	48/4	85KR	40	22	29	0.03
	47/5	133XE	41	-8.5	5.0	<0.01
	51/0	3H IN ATM. M.*	0.41	-0.40	0.032	-
	51/0	3H AS HTO IN AIR	3.1	-2.4	0.21	<0.01
LAS VEGAS NV	45/7	85KR	37	21	30	0.03
	43/9	133XE	66	-12	7.1	<0.01
	52/0	3H IN ATM. M.*	1.4	-0.34	0.18	-
	52/0	3H AS HTO IN AIR	15	-2.7	2.1	<0.01

(continued)

TABLE E-5. Continued

SAMPLING LOCATION	NUMBER SAMPLES POSITIVE/ NEGATIVE	RADIONUCLIDE	RADIOACTIVITY CONC. (PCI/M3)*			PERCENT CONC. GUIDE+ (continued)
			MAX	MIN	AVG	
LATHROP WELLS NV	49/4	85KR	42	21	29	0.03
	47/6	133XE	29	-7.2	6.6	<0.01
	53/0	3H IN ATM. M.*	0.55	-0.39	0.062	-
	53/0	3H AS HTO IN AIR	5.8	-2.0	0.40	<0.01
OVERTON NV	48/4	85KR	36	19	29	0.03
	47/5	133XE	17	-4.7	4.4	<0.01
	51/1	3H IN ATM. M.*	0.68	-0.39	0.032	-
	51/1	3H AS HTO IN AIR	4.2	-3.3	0.13	<0.01
PAHRUMP NV	47/5	85KR	38	25	30	0.03
	46/6	133XE	24	-8.3	4.4	<0.01
	51/0	3H IN ATM. M.*	0.56	-0.37	0.0087	-
	51/0	3H AS HTO IN AIR	11	-3.5	0.37	<0.01
PIOCHE NV	10/0	85KR	34	29	31	0.03
	10/0	133XE	22	-4.1	8.0	<0.01
	32/0	3H IN ATM. M.*	0.58	-0.38	0.036	-
	32/0	3H AS HTO IN AIR	3.4	-1.9	0.35	<0.01
RACHEL NV - ROBI	45/7	85KR	38	23	30	0.03
	45/7	133XE	24	-10	4.3	<0.01
	53/0	3H IN ATM. M.*	0.56	-0.30	0.057	-
	53/0	3H AS HTO IN AIR	5.1	-2.1	0.33	<0.01
TONOPAH NV	49/4	85KR	40	23	30	0.03
	48/5	133XE	47	-16	4.8	<0.01
	52/1	3H IN ATM. M.*	0.53	-0.32	0.051	-
	52/1	3H AS HTO IN AIR	3.4	-2.2	0.20	<0.01
CEDAR CITY UT	47/5	85KR	40	21	29	0.03
	44/8	133XE	27	-12	4.6	<0.01
	52/0	3H IN ATM. M.*	0.52	-0.44	0.058	-
	52/0	3H AS HTO IN AIR	3.0	-2.0	0.31	<0.01
ST GEORGE UT	49/3	85KR	35	20	29	0.03
	45/7	133XE	24	-3.2	5.5	<0.01
	50/1	3H IN ATM. M.*	0.48	-0.34	0.057	-
	50/1	3H AS HTO IN AIR	3.3	-3.1	0.39	<0.01

(continued)

TABLE E-5. Continued

SAMPLING LOCATION	NUMBER SAMPLES POSITIVE/ NEGATIVE	RADIONUCLIDE	RADIOACTIVITY CONC. (PCI/M3)* MAX	MIN	AVG	PERCENT CONC. GUIDE+
SALT LAKE CITY U	9/15	85KR	36	27	30	0.03
	8/16	133XE	16	-31	4.2	<0.01
	44/7	3H IN ATM. M.*	0.42	-0.21	0.084	-
	44/7	3H HTO IN AIR	4.9	-2.0	0.54	<0.01

* CONCENTRATIONS OF TRITIUM IN ATMOSPHERIC MOISTURE (ATM. M.) ARE EXPRESSED AS PCI PER ML OF WATER COLLECTED.

+ CONCENTRATION GUIDES USED ARE FOR EXPOSURE TO A SUITABLE SAMPLE OF THE POPULATION IN AN UNCONTROLLED AREA.

TABLE E-6. SUMMARY OF TRITIUM RESULTS FOR THE NTS NETWORK LONG-TERM HYDROLOGICAL MONITORING PROGRAM - 1985

SAMPLING LOCATION	NO. SAMPLES	TRITIUM CONCENTRATION (PCI/L) MAX	MIN	AVG	PERCENT CONC. GUIDE
WELL 1 ARMY	12	14	-5.4	1.9	<0.01
WELL 2	12	9.7	-12	0.32	<0.01
WELL 3	12	12	-7.8	3.4	<0.02
WELL 4	12	14	-6.3	3.0	<0.02
WELL 4 CP-1*	12	9.7	-7.9	1.2	<0.01
WELL 5C	9	5.4	-12	-0.78	<0.01
WELL 8	12	15	-7.4	3.2	<0.02
WELL 20*	5	5.5	-10	-1.6	<0.01
WELL A	12	15	-7.2	4.0	<0.02
WELL B TEST	12	170	140	160	0.8
WELL C	12	34	8.2	21	0.1
WELL J-13	12	5.6	-14	-1.8	<0.01
WELL U19C	12	12	-5.1	2.4	0.01
WELL UE7NS	6	3100	2000	2600	10

*Radiochemistry results:

WELL 4 CP-1

226RA	0.082	± 0.049	PCI/L
234U	5.6	± 0.23	PCI/L
235U	0.14	± 0.034	PCC/L
238U	1.6	± 0.12	PCI/L

WELL 20

90SR	0.040	± 1.0	PCI/L
226RA	0.036	± 0.053	PCI/L
234U	3.7	± 0.3	PCI/L
235U	0.038	± 0.030	PCI/L
238PU	0.0084	± 0.073	PCI/L
238U	0.87	± 0.11	PCI/L
239PU	-0.0084	± 0.048	PCI/L

TABLE E-7. TRITIUM RESULTS FOR THE LONG-TERM HYDROLOGICAL MONITORING PROGRAM - 1985

SAMPLING LOCATION	COLLECTION DATE 1985	CONC. ± 2 SIGMA TRITIUM (PCI/L)	PCT OF CONC. GUIDE
NEVADA TEST SITE NETWORK*			
SHOSHONE CA SHOSHONE SPRING	01/11	-100 ± 180*	<0.01
	06/03	-2.9 ± 8.3*	<0.01
ADAVEN NV ADAVEN SPRING	06/05	69 ± 7	0.3
	10/02	-220 ± 230*	<0.01
ALAMO NV CITY WELL 4	04/10	3.7 ± 7.5*	0.02
	09/09	-42 ± 320*	<0.01
ASH MEADOWS NV CRYSTAL POOL	02/04	-1.1 ± 5.0*	<0.01
	07/09	70 ± 180*	0.4
FAIRBANKS SPRINGS	03/05	0.22 ± 5.4*	<0.01
	08/09	-16 ± 190*	<0.01
WELL 17S-50E-14CAC	01/25	-0.39 ± 4.6*	<0.01
	02/04	-2.9 ± 4.9*	<0.01
	07/09	47 ± 180*	0.2
WELL 18S-51E-7DB	02/04	-2.9 ± 4.8*	<0.01
	07/09	-23 ± 180*	<0.01
BEAT[illegible] CIT[illegible]PLY 12S-47E-7DBD	03/05	6.6 ± 5.2*	0.03
	08/08	74 ± 190*	0.4
COFFERS WELL 11S-48-1DD	02/14	4.7 ± 4.7*	0.02
	07/08	70 ± 180*	0.4
ROAD D WELL SPICERS	03/01	0 ± 170*(a)	<0.01
	07/08	-14 ± 4*	<0.01
SARCOBATUS FLAT TOLICHA PEAK	02/07	-0.88 ± 4.6*(b)	<0.01
	07/08	-6.1 ± 4.5*	<0.01
USECOLOGY	01/03	-0.22 ± 4.7*	<0.01
	06/06	-62 ± 180*	<0.01

(continued)

TABLE E-7. Continued

SAMPLING LOCATION	COLLECTION DATE 1985	CONC. ± 2 SIGMA TRITIUM (PCI/L)	PCT OF CONC. GUIDE
BOULDER CITY NV			
LAKE MEAD INTAKE	03/07	120 ± 6	0.6
	08/08	74 ± 190*	0.4
CLARK STATION NV			
TTR WELL 6	06/04	7.8 ± 8.1*	0.04
	10/01	-45 ± 230*	<0.01
HIKO NV			
CRYSTAL SPRINGS	04/10	7.5 ± 7.6*	0.04
	09/09	-14 ± 320*	<0.01
INDIAN SPRINGS NV			
SEWER CO INC WELL 1	01/07	-0.32 ± 4.7*	<0.01
	06/03	-120 ± 180*	<0.01
USAF WELL 2	01/03	3.8 ± 4.7*	0.02
	06/03	-69 ± 180*	<0.01
LAS VEGAS NV			
WATER DISTRICT WELL 28	01/22	-17 ± 180*	<0.01
	06/10	120 ± 8	0.6
LATHROP WELLS NV			
CITY 15S 50E-18CDC	01/03	-0.66 ± 4.6*	<0.01
	06/06	50 ± 180*	0.2
NYALA NV			
SHARP'S RANCH	09/10	-120 ± 320*	<0.01
OASIS VALLEY NV			
GOSS SPRINGS	03/05	0.46 ± 5.3*	<0.01
	08/07	-29 ± 190*	<0.01
PAHRUMP NV			
CALVADA WELL 3	06/03	0.71 ± 8.3*	<0.01
	10/01	-160 ± 230*	<0.01
RACHEL NV			
PENOYER WELLS 7 AND 8	08/07	-7.2 ± 7.3*(c)	<0.01
PENOYER WELL 13	08/07	-2.6 ± 7.5*(d)	<0.01

(continued)

TABLE E-7. Continued

SAMPLING LOCATION	COLLECTION DATE 1985	CONC. ± 2 SIGMA TRITIUM (PCI/L)	PCT OF CONC. GUIDE
RACHEL NV			
PENOYER CULINARY WELL	08/07	-7.0 ± 7.3*(e)	<0.01
TEMPIUTE NV			
UNION CARBIDE WELL	01/22	-17 ± 180*	<0.01
	06/04	-6.4 ± 8.0*	<0.01
TONOPAH NV			
CITY WELL	06/04	-5.1 ± 8.3*	<0.01
	10/01	-170 ± 230*	<0.01
WARM SPRINGS NV			
TWIN SPRINGS RANCH	04/09	-45 ± 190*	<0.01
	09/10	5.6 ± 320*	0.03
NTS NV			
WELL 5B	02/04	-97 ± 180*	<0.01
	07/09	-5.3 ± 7.5*	<0.01
WELL C-1	02/05	74 ± 190*	0.4
	07/10	0.25 ± 7.2*	<0.01
TEST WELL D	03/06	-22 ± 170*	<0.01
	08/06	-7.7 ± 7.5*	<0.01
WELL U16D	02/06	-100 ± 180*	<0.01
	07/10	-11 ± 7*	<0.01
WELL UE1C	03/06	61 ± 190*	0.3
	08/06	-6.6 ± 7.4*	<0.01
WELL UE5C	02/04	7.1 ± 180*	0.04
	07/09	-7.9 ± 7.1*	<0.01
WELL UE15D	01/12	78 ± 180*	0.4
	06/14	93 ± 8	0.5

(continued)

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*FOR ALL LOCATIONS EXCEPT PENOYER WELL 7 AND 8 AND PENOYER WELL 13, SAMPLES COLLECTED DURING THE MONTHS NOT LISTED WERE GAMMA-SCANNED ONLY, AND NO GAMMA-EMITTERS WERE DETECTED. SAMPLES WERE COLLECTED FROM THE PENOYER WELLS ONLY ON THE DATE LISTED.

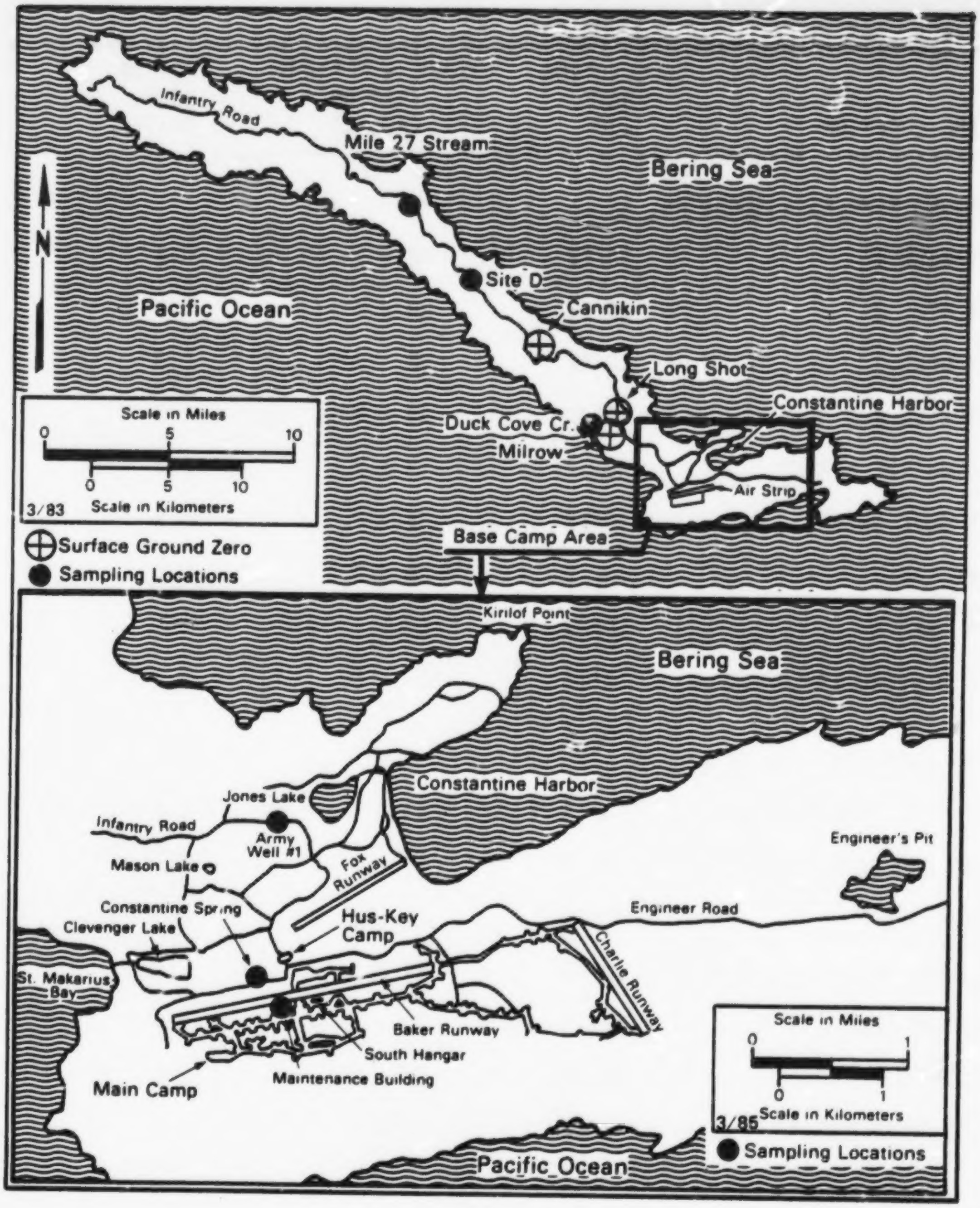
Infantry Road
Mile 27 Stream
Bering Sea
N
Site D
Pacific Ocean
Cannikin
Long Shot
Constantine Harbor
Duck Cove Cr.
Milrow
Air Strip
Scale in Miles
0
5
10
0
5
10
3/83
Scale in Kilometers
Surface Ground Zero
Sampling Locations
Base Camp Area
Kirilof Point
Bering Sea
Constantine Harbor
Jones Lake
Infantry Road
Army Well #1
Mason Lake
Fox Runway
Constantine Spring
Hus-Key Camp
Clevenger Lake
Engineer's Pit
Engineer Road
Charlie Runway
St. Makarius Bay
Baker Runway
South Hangar
Maintenance Building
Main Camp
Scale in Miles
0
1
0
1
3/85
Scale in Kilometers
Sampling Locations
Pacific Ocean

Figure E-1. Amchitka Island and background sampling locations for the LTHMP.

TABLE E-7. Continued

SAMPLING LOCATION	COLLECTION DATE 1985	CONC. ± 2 SIGMA TRITIUM (PCI/L)	PCT OF CONC. GUIDE
BACKGROUND SAMPLES - AMCHITKA, AK			
ARMY WELL 1	10/12	42 ± 7	0.2
ARMY WELL 2	10/12	20 ± 7	0.1
ARMY WELL 3	10/12	56 ± 7	0.3
ARMY WELL 4	10/13	53 ± 7	0.3
CONSTANTINE SPRING	10/12	62 ± 7	0.3
DUCK COVE CREEK	10/12	31 ± 7	0.2
JONES LAKE	10/12	24 ± 7	0.1
RAIN SAMPLE	10/29	LOST	
SITE D HYDRO EXPLOR HOL	10/17	78 ± 8	0.4
PROJECT CANNIKIN - AMCHITKA, AK			
NORTH END CANNIKIN LAKE	10/13	39 ± 8	0.2
SOUTH END CANNIKIN LAKE	10/13	36 ± 7	0.2
DK-45 LAKE	10/17	31 ± 6	0.2
ICE BOX LAKE	10/13	33 ± 7	0.2
PIT S OF CANNIKIN GZ	10/13	20 ± 7	0.1
WELL HTH-3	10/13	43 ± 6	0.2
WHITE ALICE CREEK	10/13	24 ± 7	0.1

(continued)

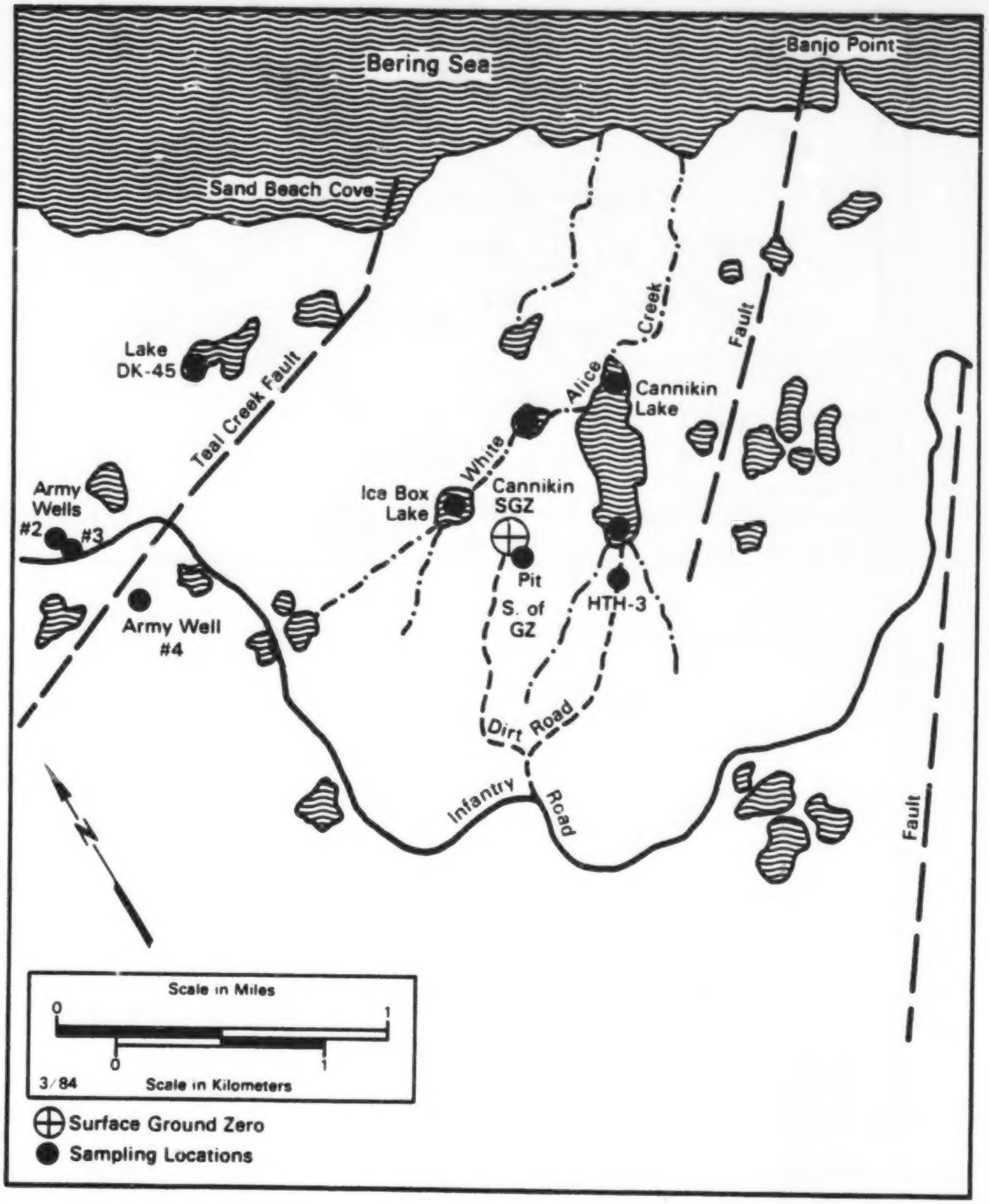
Bering Sea
Banjo Point
Sand Beach Cove
Lake DK-45
Teal Creek Fault
Alice Creek
White Alice Creek
Fault
Cannikin Lake
Army Wells #2 #3
Ice Box Lake
Cannikin SGZ
Pit
S. of GZ
HTH-3
Army Well #4
Dirt Road
Infantry Road
N
Fault
Scale in Miles
0
1
0
1
3/84
Scale in Kilometers
Surface Ground Zero
Sampling Locations

Figure E-2. LTHMP sampling locations for Project Cannikin.

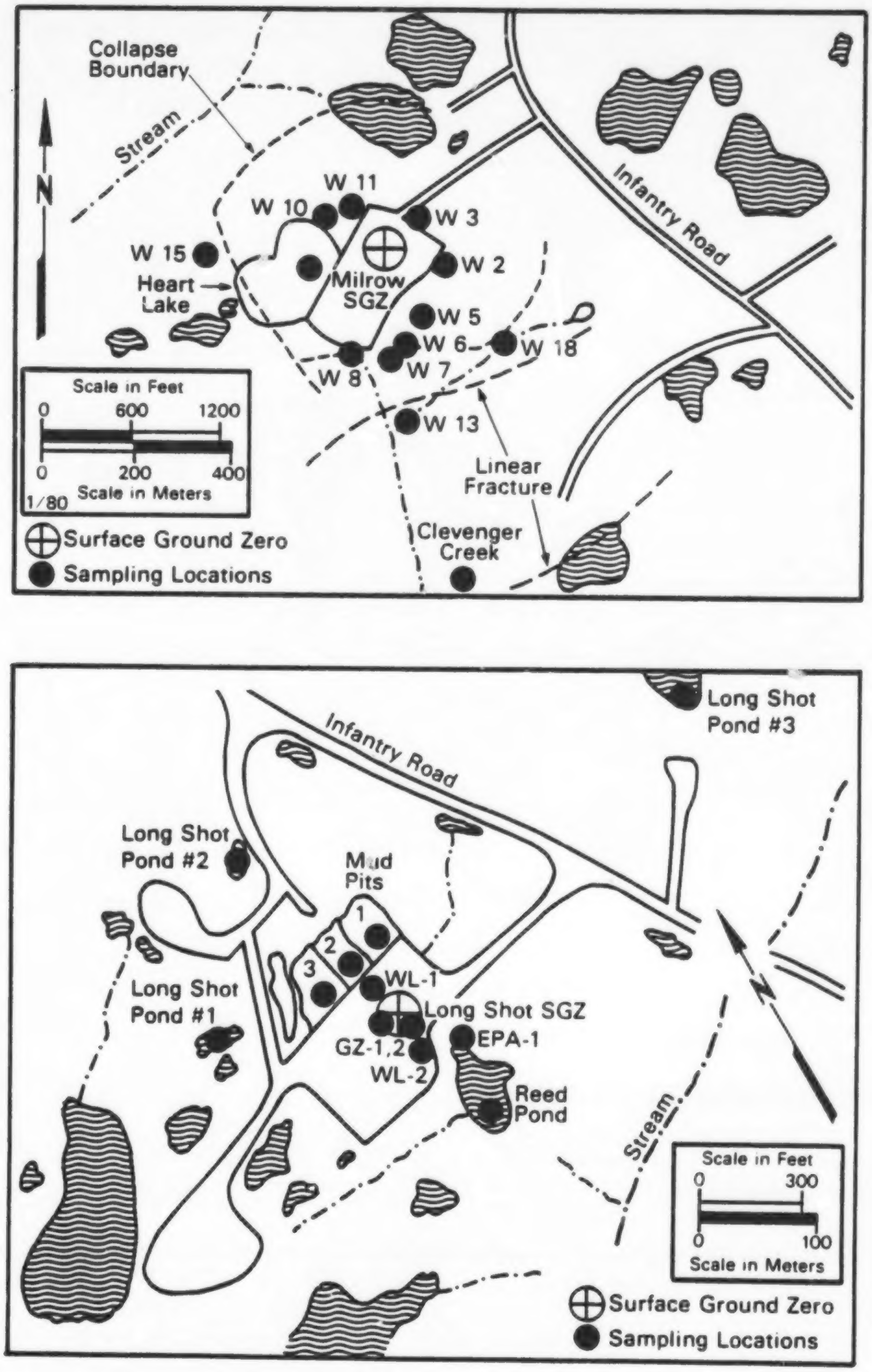
Collapse Boundary
Stream
N
W 11
W 10
W 3
W 15
W 2
Heart Lake
Milrow SGZ
W 5
W 6
W 18
W 7
W 8
W 13
Infantry Road
Scale in Feet
0
600
1200
0
200
400
Scale in Meters
1/80
Linear Fracture
Clevenger Creek
Surface Ground Zero
Sampling Locations
Long Shot Pond #3
Infantry Road
Long Shot Pond #2
Mud Pits
1
2
3
WL-1
Long Shot Pond #1
Long Shot SGZ
GZ-1,2
EPA-1
WL-2
Reed Pond
Stream
N
Scale in Feet
0
300
0
100
Scale in Meters
Surface Ground Zero
Sampling Locations

Figure E-3. LTHMP sampling locations for Projects Milrow and Long Shot.

TABLE E-7. Continued

SAMPLING LOCATION	COLLECTION DATE 1985	CONC. ± 2 SIGMA TRITIUM (PCI/L)	PCT OF CONC. GUIDE
PROJECT LONGSHOT - AMCHITKA, AK			
STREAM EAST OF LONGSHOT	10/14	130 ± 7(j)	0.6
EPA WELL-1	10/14	320 ± 9	2
LONG SHOT POND 1	10/14	22 ± 6	0.1
LONG SHOT POND 2	10/14	27 ± 7	0.1
LONG SHOT POND 3	10/14	34 ± 7	0.2
MUD PIT 1	10/14	380 ± 8	2
MUD PIT 2	10/14	540 ± 11	3
MUD PIT 3	10/14	500 ± 10	2
REED POND	10/14	28 ± 6	0.1
WELL GZ 1	10/14	2800 ± 220	10
WELL GZ 2	10/14	170 ± 8	0.9
WELL WL-1	10/14	25 ± 7	0.1
WELL WL-2	10/14	240 ± 8	1
PROJECT MILROW - AMCHITKA, AK			
CLEVENGER CREEK	10/14	30 ± 8	0.1
HEART LAKE	10/14	21 ± 6	0.1
WELL W-2	10/14	24 ± 8	0.1
WELL W-3	10/14	25 ± 7	0.1
WELL W-4	10/14	31 ± 7	0.2
WELL W-6	10/14	41 ± 7	0.2
WELL W-7	10/14	30 ± 7	0.2

(continued)

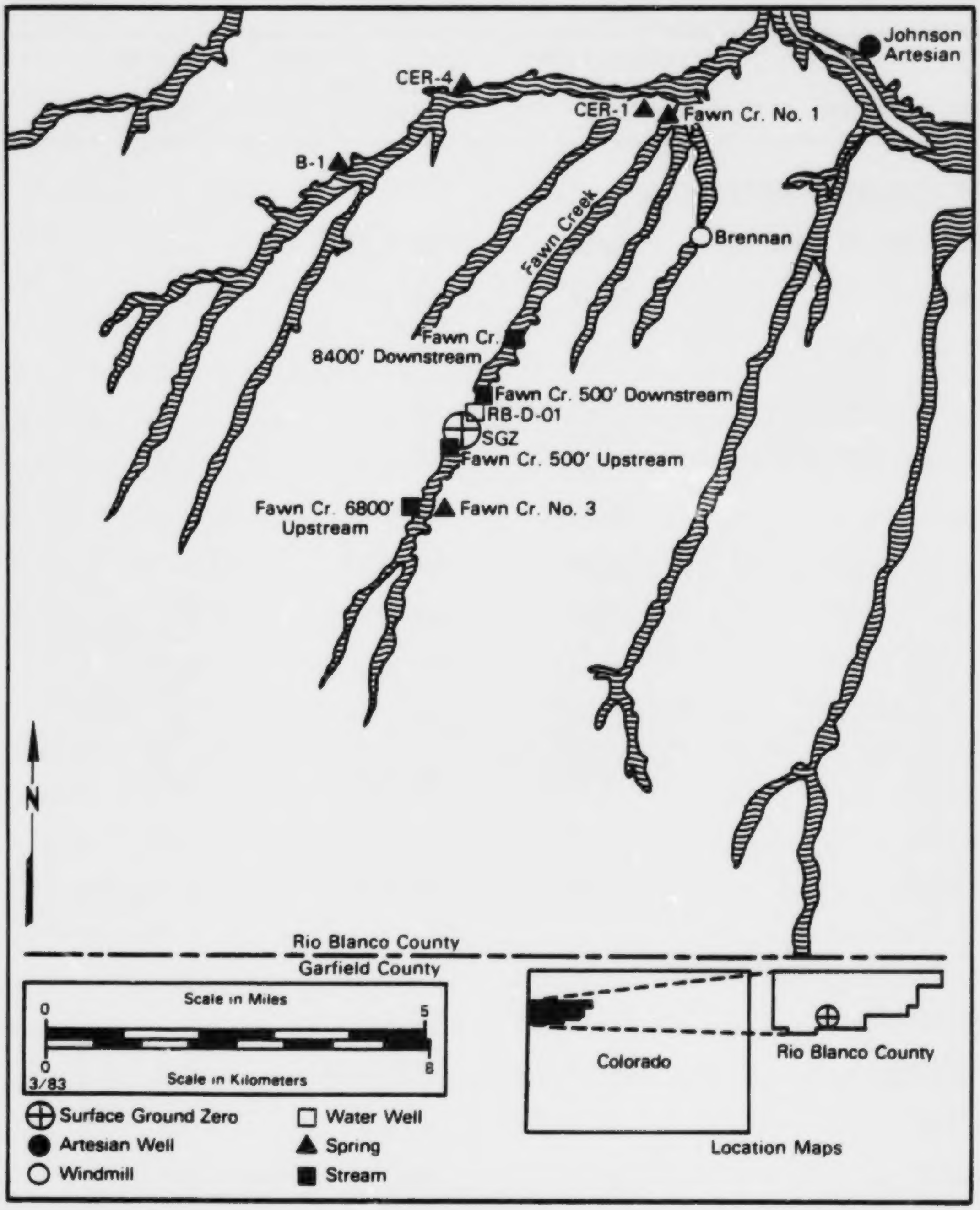
Johnson Artesian
CER-4
CER-1
Fawn Cr. No. 1
B-1
Fawn Creek
Brennan
Fawn Cr. 8400' Downstream
Fawn Cr. 500' Downstream
RB-D-01
SGZ
Fawn Cr. 500' Upstream
Fawn Cr. 6800' Upstream
Fawn Cr. No. 3
N
Rio Blanco County
Garfield County
Scale in Miles
0
5
0
8
3/83
Scale in Kilometers
Surface Ground Zero
Artesian Well
Windmill
Water Well
Spring
Stream
Colorado
Rio Blanco County
Location Maps

Figure E-4. LTHMP sampling locations for Project Rio Blanco.

TABLE E-7. Continued

SAMPLING LOCATION	COLLECTION DATE 1985	CONC. ± 2 SIGMA TRITIUM (PCI/L)	PCT OF CONC. GUIDE
PROJECT MILROW - AMCHITKA, AK			
WELL W-8	10/14	31 ± 7	0.2
WELL W-10	10/14	34 ± 7	0.2
WELL W-11	10/14	93 ± 7	0.5
WELL W-13	10/14	53 ± 7	0.3
WELL W-14	10/14	26 ± 7	0.1
WELL W-15	10/14	22 ± 6	0.1
WELL W-17	10/14	26 ± 7	0.1
WELL W-18	10/14	49 ± 7	0.2
PROJECT RIO BLANCO - COLORADO			
RIO BLANCO CO B-1 EQUITY CAMP	06/24	100 ± 7	0.5
BRENNAN WINDMILL	06/24	12 ± 7	0.06
CER 1 BLACK SULPHUR	06/24	63 ± 7	0.3
CER 4 BLACK SULPHUR	06/24	110 ± 8	0.5
FAWN CREEK 1	06/21	67 ± 7	0.3
FAWN CREEK 6800FT UPSTR	06/21	86 ± 7	0.4
FAWN CREEK 500FT UPSTRE	06/21	70 ± 7	0.4
FAWN CREEK 500FT DNSTR	06/21	81 ± 7	0.4
FAWN CREEK 8400FT DNSTR	06/21	76 ± 7	0.4
JOHNSON ARTESIAN WELL	06/21	4.9 ± 8.1*	0.02
WELL RB-D-01	06/25	1.0 ± 4.3*	<0.01

(continued)

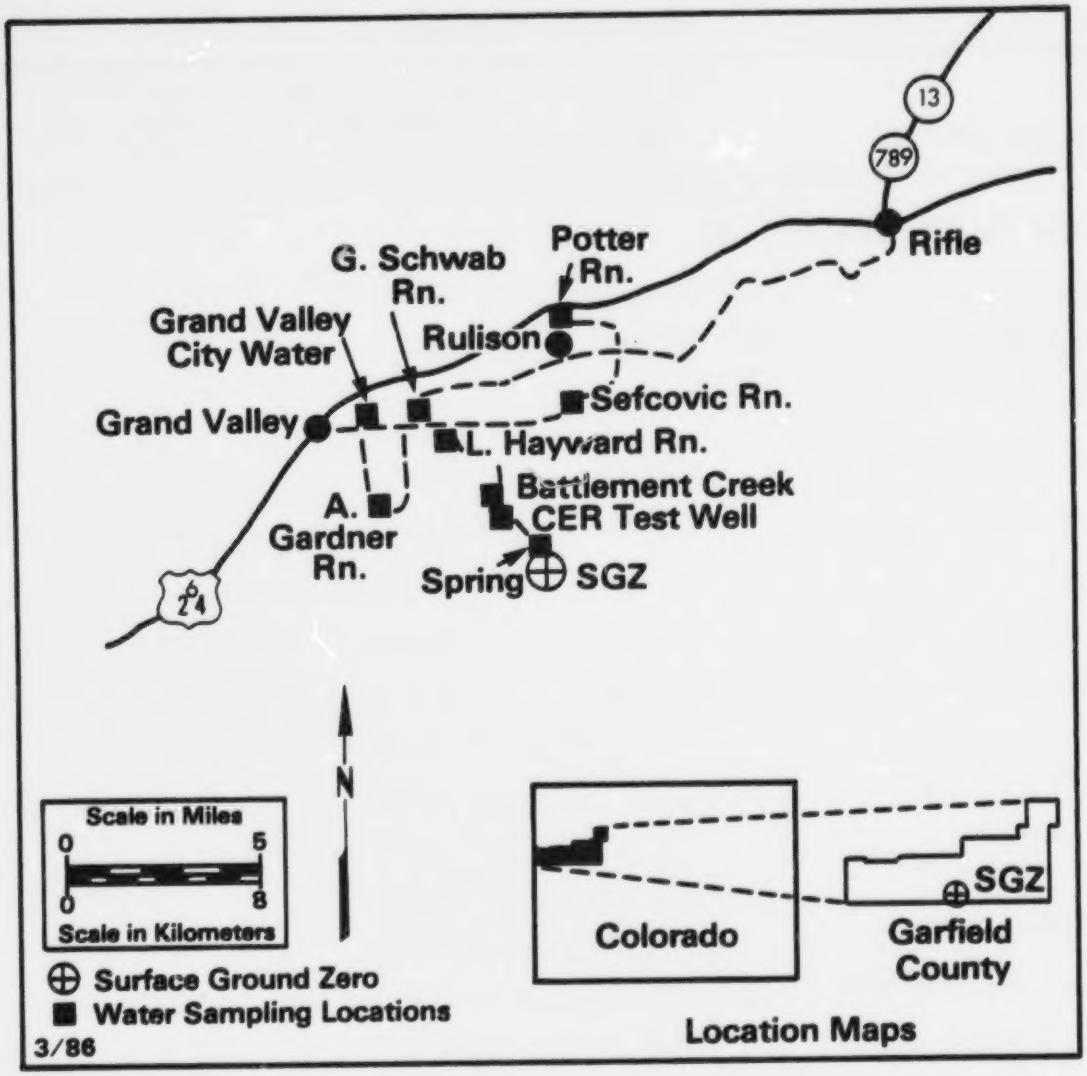
13
789
Rifle
Potter Rn.
G. Schwab Rn.
Grand Valley City Water
Rulison
Grand Valley
Sefcovic Rn.
L. Hayward Rn.
Battlement Creek
CER Test Well
A. Gardner Rn.
Spring
SGZ
6 24
N
Scale in Miles
0
5
0
8
Scale in Kilometers
⊕ Surface Ground Zero
■ Water Sampling Locations
3/86
Colorado
SGZ
Garfield County
Location Maps

Figure E-5. LTHMP sampling locations for Project Rulison.

TABLE E-7. Continued

SAMPLING LOCATION	COLLECTION DATE 1985	CONC. ± 2 SIGMA TRITIUM (PCI/L)	PCT OF CONC. GUIDE
PROJECT RULISON - COLORADO			
GRAND VALLEY CO			
CITY SPRING	06/20	-6.2 ± 7.7*	<0.01
ALBERT GARDNER RANCH	06/19	200 ± 8	1
RULISON CO			
LEE HAYWARD RANCH	06/20	280 ± 9	1
POTTER RANCH	06/20	150 ± 8	0.8
ROBERT SEARCY RANCH (G. SCHWAB)	06/20	170 ± 9	0.9
FELIX SEFCOVIC RANCH	06/20	210 ± 8	1
GRAND VALLEY CO			
BATTLEMENT CREEK	06/19	130 ± 8	0.6
SPRING 300 YRDS NW OF GZ	06/19	130 ± 8	0.6
CER TEST WELL	06/19	210 ± 9	1
PROJECT DRIBBLE - MISSISSIPPI			
BAXTERVILLE MS			
BAXTERVILLE CITY WELL	04/23	55 ± 7	0.3
COLUMBIA MS			
CITY WELL 64B	04/23	30 ± 7	0.2
LUMBERTON MS			
CITY WELL 2	04/23	22 ± 7	0.1
PURVIS MS			
CITY SUPPLY	04/22	18 ± 7	0.09
BAXTERVILLE MS			
HALF MOON CREEK	04/22 04/22	78 ± 7 70 ± 7	0.4 0.3
LOWER LITTLE CREEK	04/23	69 ± 8	0.3

(continued)

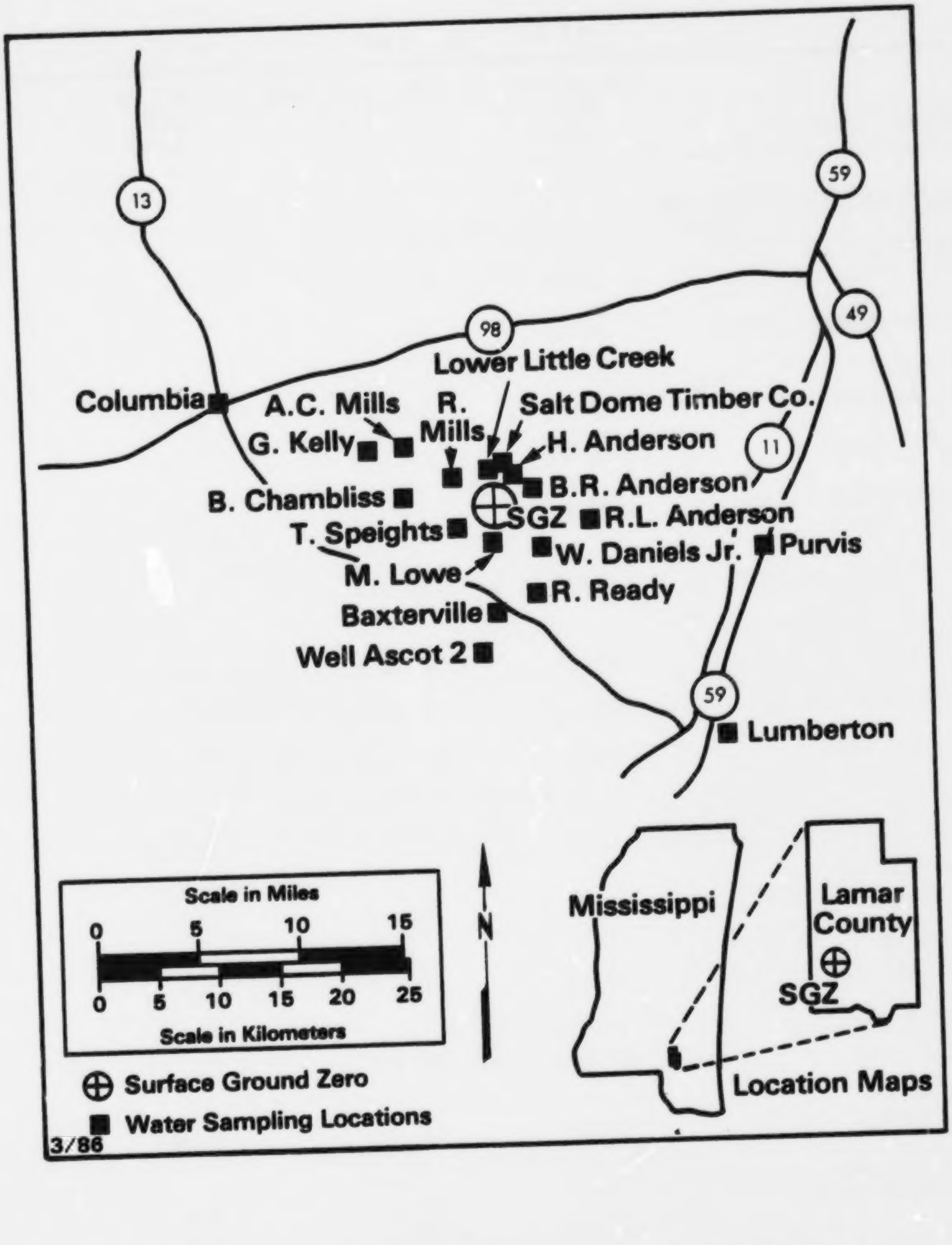
13
59
98
49
11
59
Lower Little Creek
Columbia
A.C. Mills
R. Mills
Salt Dome Timber Co.
G. Kelly
H. Anderson
B.R. Anderson
B. Chambliss
SGZ
R.L. Anderson
T. Speights
W. Daniels Jr.
Purvis
M. Lowe
R. Ready
Baxterville
Well Ascot 2
Lumberton
Scale in Miles
0
5
10
15
0
5
10
15
20
25
Scale in Kilometers
N
Mississippi
Lamar County
SGZ
Location Maps
Surface Ground Zero
Water Sampling Locations
3/86

Figure E-6. LTHMP sampling locations for Project Dribble - towns and residences.

TABLE E-7. Continued

SAMPLING LOCATION	COLLECTION DATE 1985	CONC. ± 2 SIGMA TRITIUM (PCI/L)	PCT OF CONC. GUIDE
BAXTERVILLE MS			
B R ANDERSON	04/22	97 ± 7	0.5
H ANDERSON	04/22	150 ± 8	0.7
R L ANDERSON	04/22	110 ± 7	0.5
B CHAMBLISS	04/22	36 ± 7	0.2
W DANIELS JR	04/22	120 ± 7	0.6
G KELLY	04/22	37 ± 7	0.2
M LOWE	04/22	NO SAMPLE; PUMP OUT	
A C MILLS	04/22	23 ± 7	0.1
R MILLS	04/22	49 ± 7	0.2
R READY	04/22	88 ± 7	0.4
T SPEIGHTS	04/23	71 ± 7	0.4
WELL ASCOT 2	04/22	13 ± 7	0.06
HALF MOON CREEK OVRFLW	04/22	760 ± 160	4
	04/22	350 ± 9	2
WELL E-7	04/23	20 ± 7	0.1
WELL HM-1	04/22	16 ± 7	0.08
WELL HM-2A	04/22	21 ± 7	0.1
WELL HM-2B	04/22	5.6 ± 7.6*	0.03
WELL HM-3	04/22	4.4 ± 7.3*	0.02
	04/22	-1.2 ± 7.3*	<0.01
	04/22	-6.9 ± 7.6*	<0.01
	04/22	-3.5 ± 7.1*	<0.01
	04/22	9.1 ± 7.4*	0.05
WELL HMH-1	04/21	31000 ± 350	200
	04/22	35000 ± 360	200

(continued)

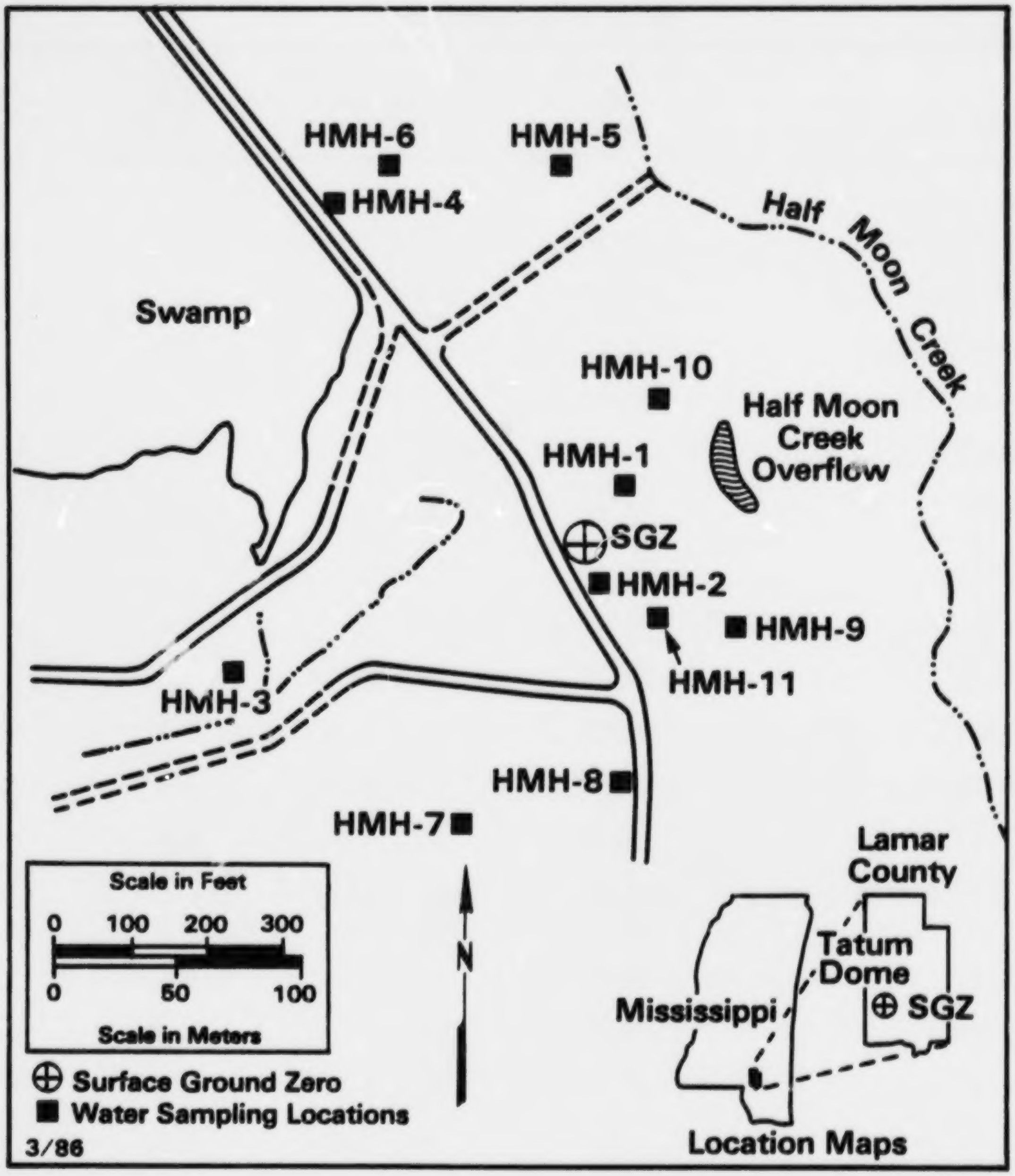
HMH-6
HMH-5
HMH-4
Half Moon Creek
Swamp
HMH-10
Half Moon Creek Overflow
HMH-1
SGZ
HMH-2
HMH-9
HMH-11
HMH-3
HMH-8
HMH-7
Scale in Feet
0
100
200
300
0
50
100
Scale in Meters
N
Lamar County
Tatum Dome
Mississippi
SGZ
Surface Ground Zero
Water Sampling Locations
Location Maps
3/86

Figure E-7. LTHMP sampling locations for Project Dribble - near GZ.

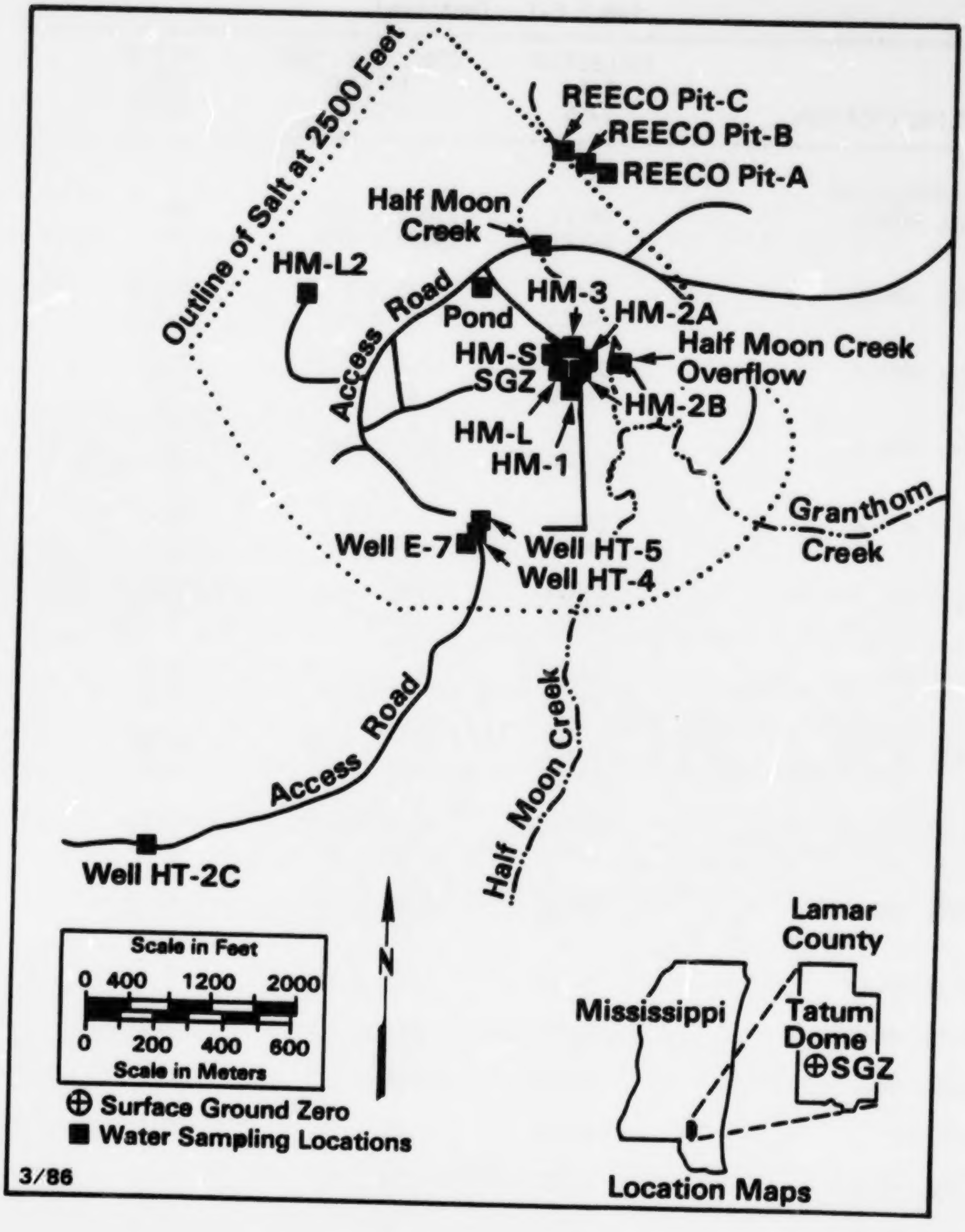
REECO Pit-C
REECO Pit-B
REECO Pit-A
Outline of Salt at 2500 Feet
Half Moon Creek
HM-L2
Access Road
Pond
HM-3
HM-2A
HM-S
SGZ
Half Moon Creek Overflow
HM-2B
HM-L
HM-1
Granthom Creek
Well E-7
Well HT-5
Well HT-4
Access Road
Half Moon Creek
Well HT-2C
N
Scale in Feet
0 400 1200 2000
0 200 400 600
Scale in Meters
⊕ Surface Ground Zero
■ Water Sampling Locations
Lamar County
Mississippi
Tatum Dome
⊕SGZ
Location Maps
3/86

Figure E-8. LTHMP sampling locations for Project Dribble - near Salt Dome.

TABLE E-7. Continued

SAMPLING LOCATION	COLLECTION DATE 1985	CONC. ± 2 SIGMA TRITIUM (PCI/L)	PCT OF CONC. GUIDE
BAXTERVILLE MS			
WELL HMH-2	04/21	13000 ± 250	60
	04/22	14000 ± 260	70
WELL HMH-3	04/21	35 ± 7	0.2
	04/22	83 ± 8	0.4
WELL HMH-4	04/21	-7.4 ± 7.8*	<0.01
	04/22	63 ± 7	0.3
WELL HMH-5	04/21	2500 ± 180	10
	04/22	2700 ± 180	10
WELL HMH-6	04/21	170 ± 8	0.8
	04/22	200 ± 8	1
WELL HMH-7	04/21	160 ± 8	0.8
	04/22	220 ± 8	1
WELL HMH-8	04/21	1.6 ± 7.9*	<0.01
	04/22	35 ± 7	0.2
WELL HMH-9	04/21	1.7 ± 8.3*	<0.01
	04/22	73 ± 7	0.4
WELL HMH-10	04/21	-6.7 ± 7.7*	<0.01
	04/22	12 ± 7	0.06
WELL HMH-11	04/21	2900 ± 180	10
	04/22	1400 ± 170	7
WELL HM-L	04/22	1600 ± 170	8
WELL HM-L2	04/22	2.6 ± 7.9*	0.01
WELL HM-S	04/22	16000 ± 270	80
HT-2C	04/23	29 ± 7	0.1
WELL HT-4	04/23	29 ± 7	0.1
WELL HT-5	04/23	18 ± 7	0.09

(continued)

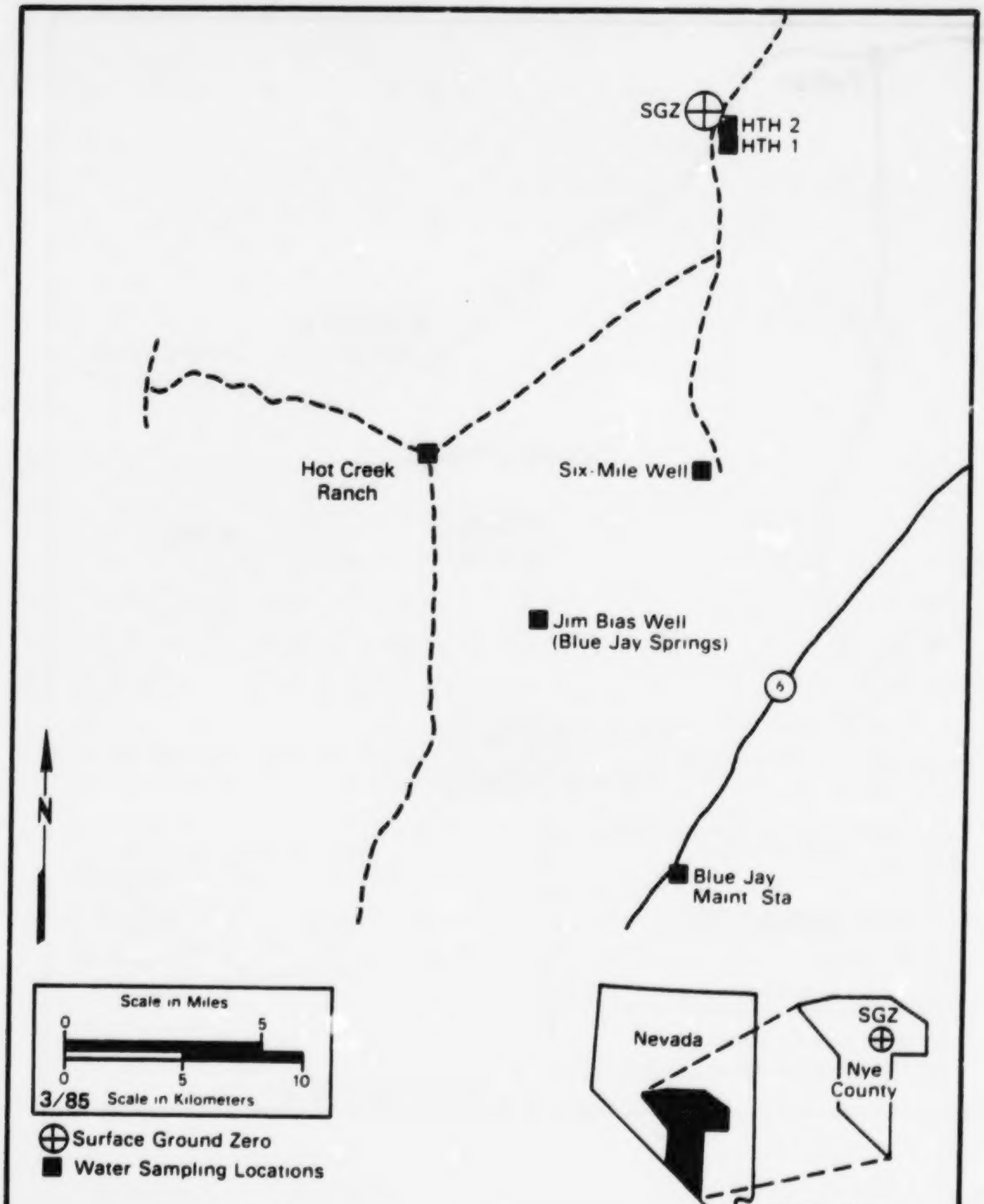
SGZ
HTH 2
HTH 1
Hot Creek Ranch
Six-Mile Well
Jim Bias Well (Blue Jay Springs)
6
Blue Jay Maint Sta
N
Scale in Miles
0
5
0
5
10
3/85
Scale in Kilometers
Surface Ground Zero
Water Sampling Locations
Nevada
SGZ
Nye County
Location Maps

Figure E-9. LTHMP sampling locations for Project Faultless.

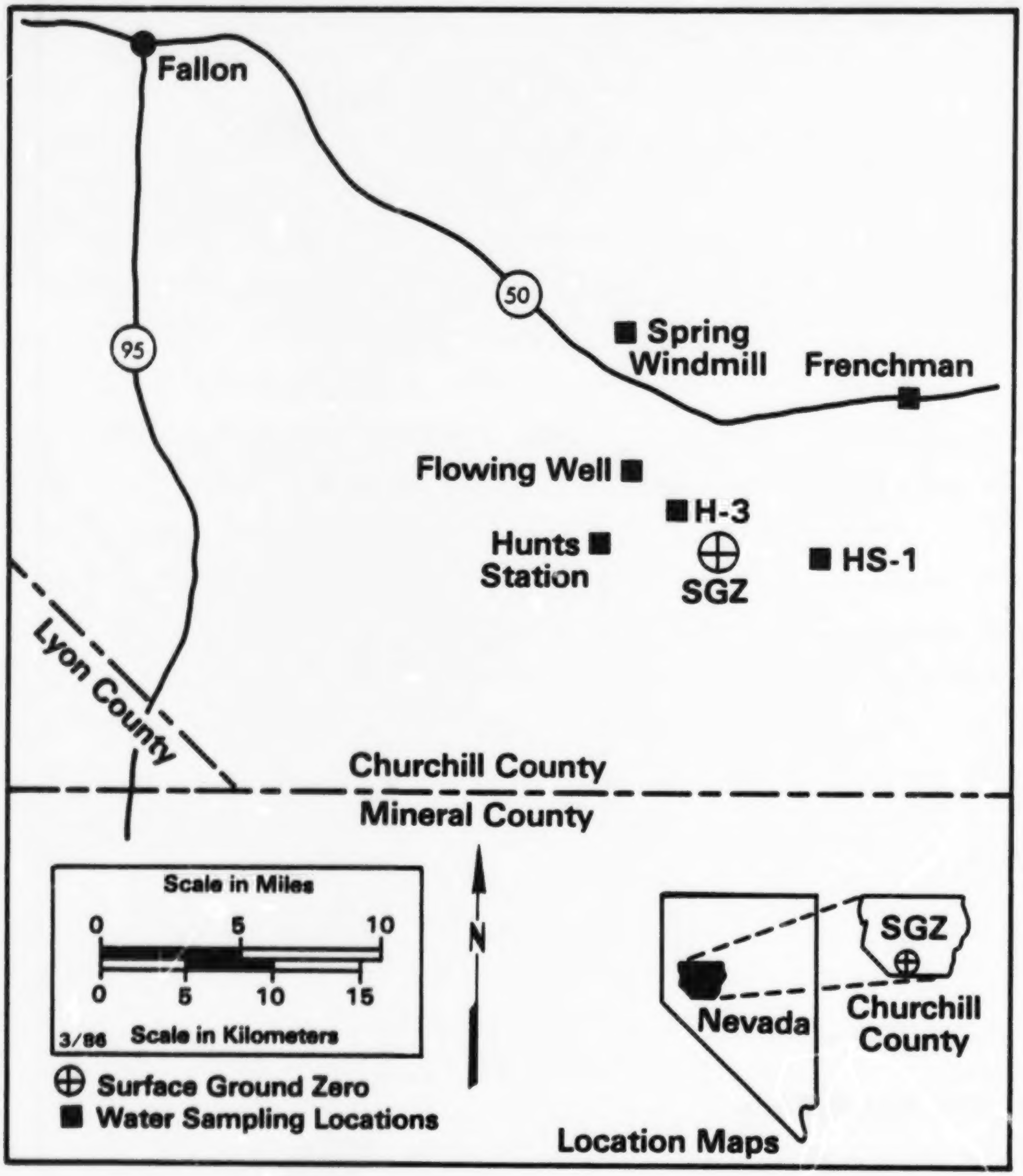
Fallon
50
95
Spring Windmill
Frenchman
Flowing Well
H-3
Hunts Station
SGZ
HS-1
Lyon County
Churchill County
Mineral County
Scale in Miles
0
5
10
0
5
10
15
3/86
Scale in Kilometers
N
⊕ Surface Ground Zero
■ Water Sampling Locations
SGZ
Nevada
Churchill County
Location Maps

Figure E-10. LTHMP sampling locations for Project Shoal.

TABLE E-7. Continued

SAMPLING LOCATION	COLLECTION DATE 1985	CONC. ± 2 SIGMA TRITIUM (PCI/L)	PCT OF CONC. GUIDE
BAXTERVILLE MS			
POND WEST OF GZ	04/22 04/22	51 ± 7 57 ± 7	0.3 0.3
REECO PIT DRAINAGE-A	04/22	70 ± 7	0.4
REECO PIT DRAINAGE-B	04/22	2500 ± 170	10
REECO PIT DRAINAGE-C	04/22	1600 ± 170	8
SALT DOME TIMBER CO	04/22	42 ± 7	0.2
PROJECT FAULTLESS - NEVADA			
BLUE JAY NV			
BIAS WELL	07/15	-3.7 ± 7.3*	<0.01
MAINTENANCE STATION	07/15	-13 ± 7*	<0.01
SIX MILE WELL	07/15	NO SAMPLE; PUMP OUT	
HTH-1 WELL	07/15	-12 ± 8*	<0.01
HTH-2 WELL	07/15	-7.1 ± 7.3*	<0.01
HOT CREEK RANCH	07/15	0 ± 7.4*	<0.01
PROJECT SHOAL - NEVADA			
FRENCHMAN STATION NV			
HUNTS STATION	02/20	-3.0 ± 5.2*	<0.01
FLOWING WELL	02/21	2.6 ± 5.1*	0.01
FRENCHMAN STATION	02/21	0.79 ± 5.7*	<0.01
WELL H-3	02/20	-3.9 ± 5.2*	<0.01
WELL HS-1	02/21	2.7 ± 5.2*	0.01
FALLON NV			
SPRING WINDMILL	02/20	0.12 ± 5.3*$^{(f)}$	<0.01

(continued)

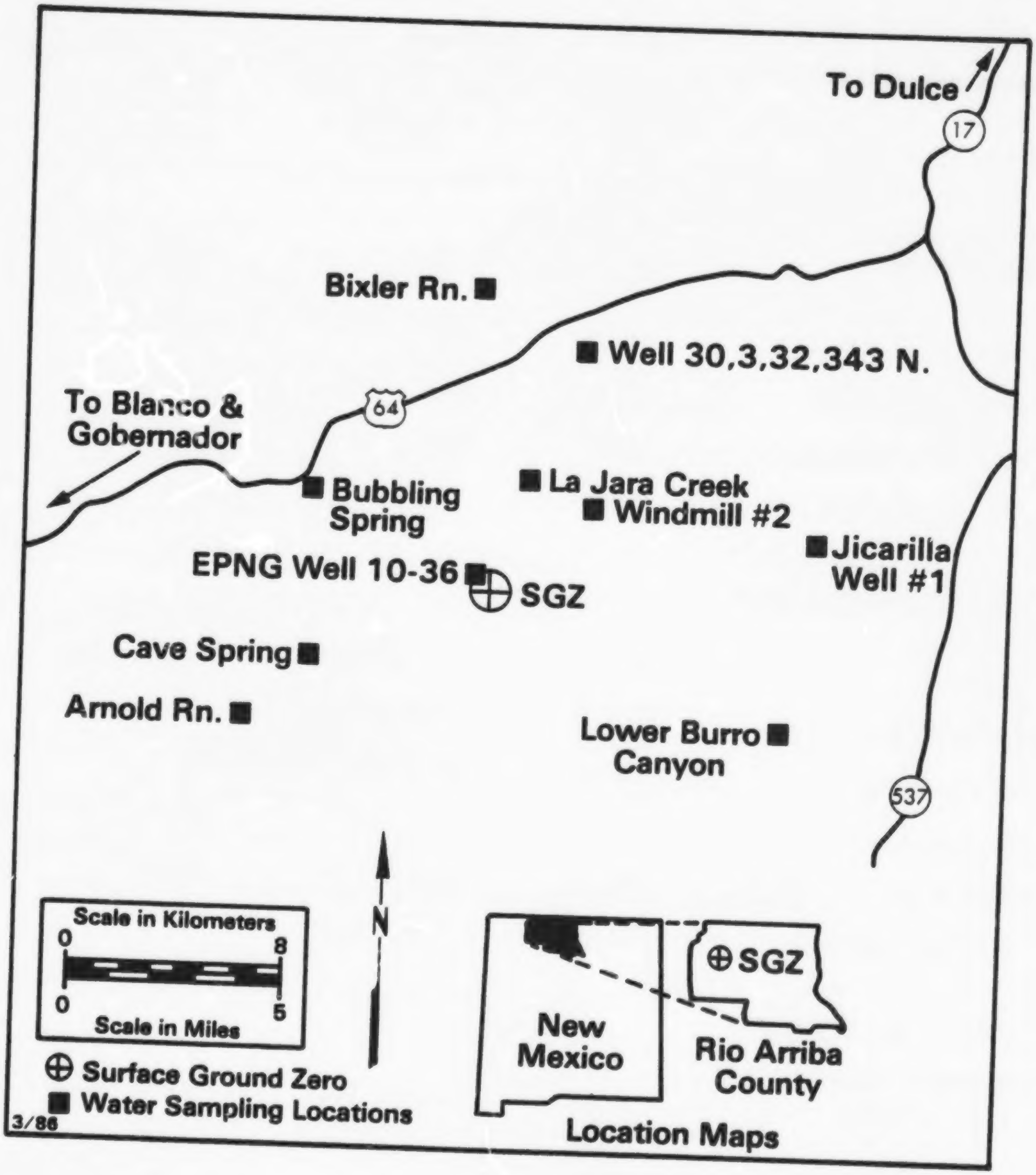
To Dulce
17
Bixler Rn.
Well 30,3,32,343 N.
To Blanco & Gobernador
64
Bubbling Spring
La Jara Creek
Windmill #2
Jicarilla Well #1
EPNG Well 10-36
SGZ
Cave Spring
Arnold Rn.
Lower Burro Canyon
537
Scale in Kilometers
0
8
0
5
Scale in Miles
N
SGZ
New Mexico
Rio Arriba County
⊕ Surface Ground Zero
■ Water Sampling Locations
3/86
Location Maps

Figure E-11. LTHMP sampling locations for Project Gasbuggy.

TABLE E-7. Continued

SAMPLING LOCATION	COLLECTION DATE 1985	CONC. ± 2 SIGMA TRITIUM (PCI/L)	PCT OF CONC. GUIDE
PROJECT GASBUGGY - NEW MEXICO			
GOBERNADOR NM			
ARNOLD RANCH	05/21	1.6 ± 6.9*	<0.01
BIXLER RANCH	05/22	21 ± 6	0.1
BUBBLING SPRINGS	05/19	75 ± 7	0.4
CAVE SPRINGS	05/22	80 ± 7	0.4
LA JARA CREEK	05/19	90 ± 7	0.4
LOWER BURRO CANYON	05/20	63 ± 7	0.3
WELL 30.3.32.343 NORTH	05/23	54 ± 7(g)	0.3
JICARILLA WELL 1	05/20	7.2 ± 6.8*	0.04
WINDMILL 2	05/22	NO SAMPLE; PUMP OUT	
EPNG WELL 10-36	05/23	390 ± 9	2
PROJECT GNOME - NEW MEXICO			
CARLSBAD NM			
CARLSBAD CITY WELL 7	05/17	-2.2 ± 7.3*	<0.01
LOVING NM			
CITY WATER WELL 2	05/17	6.3 ± 7.2*	0.03
MALAGA NM			
PECOS PUMPING STATION	05/17	3.3 ± 7.1*	0.02
PHS WELL 6	05/15	72 ± 7	0.4
PHS WELL 8	05/15	21 ± 7	0.1
PHS WELL 9	05/15	7.6 ± 7.0*	0.04
PHS WELL 10	05/15	5.8 ± 7.4*	0.03
USGS WELL 1	05/15	6.3 ± 6.9*	0.03

(continued)

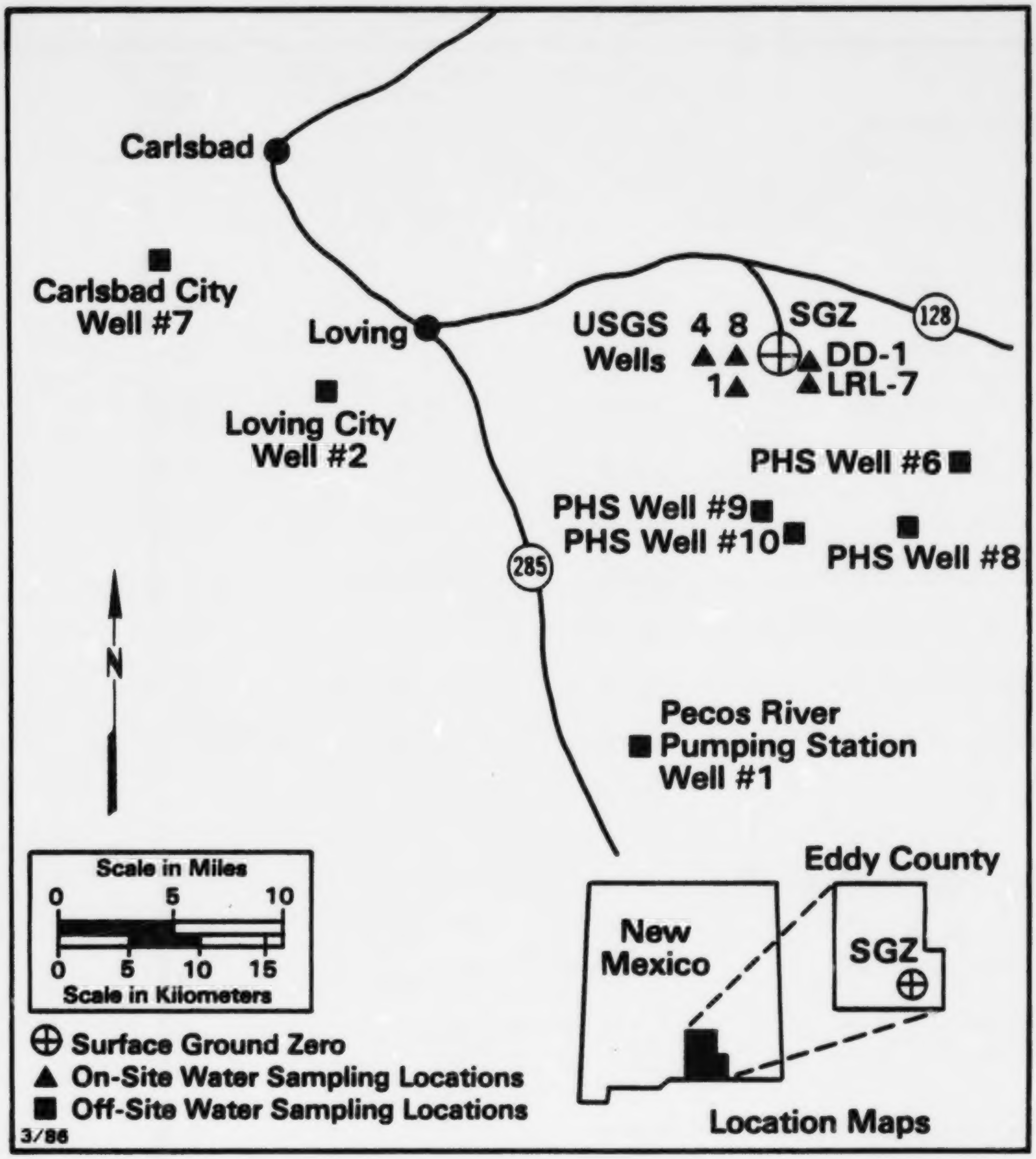
Carlsbad
Carlsbad City Well #7
Loving
Loving City Well #2
USGS Wells 4 8 1
SGZ
128
DD-1
LRL-7
PHS Well #6
PHS Well #9
PHS Well #10
PHS Well #8
285
N
Pecos River Pumping Station Well #1
Scale in Miles
0 5 10
0 5 10 15
Scale in Kilometers
Eddy County
New Mexico
SGZ
Location Maps
⊕ Surface Ground Zero
▲ On-Site Water Sampling Locations
■ Off-Site Water Sampling Locations
3/86

Figure E-12. LTHMP sampling locations for Project Gnome.

TABLE E-7. Continued

SAMPLING LOCATION	COLLECTION DATE 1985	CONC. ± 2 SIGMA TRITIUM (PCI/L)	PCT OF CONC. GUIDE
MALAGA NM			
USGS WELL 4	05/16	260000 ± 910	1000
USGS WELL 8	05/16	190000 ± 780(h)	900
WELL LRL-7	05/16	17000 ± 280(i)	90

* CONCENTRATION IS LESS THAN THE MINIMUM DETECTABLE CONCENTRATION (MDC).

FOOTNOTES

	ANALYSIS	RESULT	2SIGMA	UNITS
a	90SR	0.26	1.7*	PCI/L
	226RA	0.036	0.056*	PCI/L
	234U	3.9	0.2	PCI/L
	235U	0.075	0.026	PCI/L
	238PU	-0.052	0.076*	PCI/L
	238U	1.9	0.2	PCI/L
	239PU	-0.026	0.050*	PCI/L
b	90SR	0.28	1.5*	PCI/L
	226RA	0.097	0.061	PCI/L
	234U	2.7	0.2	PCI/L
	235U	0.019	0.019*	PCI/L
	238PU	-0.039	0.068*	PCI/L
	238U	0.80	0.09	PCI/L
	239PU	-0.016	0.045*	PCI/L
c	90SR	-0.019	2.2*	PCI/L
	226RA	0.094	0.060	PCI/L
	234U	3.4	0.3	PCI/L
	235U	0.044	0.046*	PCI/L
	238PU	-0.015	0.033*	PCI/L
	238U	1.1	0.2	PCI/L
	239PU	-0.0038	0.022*	PCI/L
d	90SR	-0.051	1.4*	PCI/L
	226RA	0.038	0.064*	PCI/L
	234U	2.0	0.2	PCI/L
	235U	0.033	0.018	PCI/L
	238PU	-0.034	0.043*	PCI/L
	238U	0.99	0.10	PCI/L
	239PU	-0.0098	0.028*	PCI/L

(continued)

TABLE E-7. Continued

SAMPLING LOCATION		COLLECTION DATE 1985	CONC. ± 2 SIGMA TRITIUM (PCI/L)	PCT OF CONC. GUIDE
[e] 90SR	0.0076	0.86*	PCI/L	
226RA	0.14	0.07	PCI/L	
234U	1.6	0.2	PCI/L	
235U	0.011	0.033*	PCI/L	
238PU	0.010	0.043*	PCI/L	
238U	0.54	0.10	PCI/L	
239PU	1.5E-06	0.028*	PCI/L	
[f] 90SR	-0.011	0.98*	PCI/L	
226RA	0.086	0.074*	PCI/L	
234U	0.037	0.058*	PCI/L	
235U	0.0037	0.038*	PCI/L	
238PU	-0.021	0.090*	PCI/L	
238U	0.079	0.040	PCI/L	
239PU	-0.021	0.059*	PCI/L	
[g] 226RA	0.054	0.058*	PCI/L	
234U	5.9	0.4	PCI/L	
235U	0.15	0.05	PCI/L	
238U	3.5	0.3	PCI/L	
238PU	0.11	0.22*	PCI/L	
239PU	0.081	0.15*	PCI/L	
[h] 137CS	58	11	PCI/L	
[i] 137CS	210	17	PCI/L	
[j] 226RA	0.019	0.076*	PCI/L	
234U	0.12	0.039	PCI/L	
235U	0.026	0.033*	PCI/L	
238U	0.055	0.025	PCI/L	
238PU	-0.005	0.032*	PCI/L	
239PU	0.0	0.014*	PCI/L	

TABLE E-8. SUMMARY OF ANALYTICAL RESULTS FOR THE MILK SURVEILLANCE NETWORK - 1985

SAMPLING LOCATION	SAMPLE TYPE	NO. OF SAMPLES	RADIO-NUCLIDE	RADIOACTIVITY CONC. (PCI/L)		
				MAX	MIN	AVG
BENTON, CA, IRENE BROWN RANCH	10	1	3H	130	130	130
BISHOP, CA, WHITE MOUNTAIN RANCH	13	2	3H	310	270	290
		1	89SR	1.3	1.3	1.3
		1	90SR	1.3	1.3	1.3
HINKLEY, CA, BILL NELSON DAIRY	12	5	3H	380	140	240
		5	89SR	0.41	-2.8	-1.2
		5	90SR	1.6	-0.021	0.85
RIDGECREST, CA, CEDARSAGE FARM	10	3	3H	260	-34	150
		3	89SR	-0.26	-0.93	-0.55
		3	90SR	0.94	0.34	0.65
AUSTIN, NV, YOUNG'S RANCH	13	5	3H	440	130	270
		5	89SR	9.2	-0.66	2.9
		5	90SR	1.6	0.38	0.80
CURRANT, NV, BLUE EAGLE RANCH	13	2	3H	310	100	210
		1	89SR	0.72	0.72	0.72
		1	90SR	0.81	0.81	0.81
CURRANT, NV, MANZONIE RANCH	13	4	3H	460	130	260
		4	89SR	-0.13	-3.4	-1.2
		4	90SR	1.4	0.35	0.89
DYER, NV, OZEL LEMON	13	3	3H	290	180	240
		1	89SR	-0.065	-0.065	-0.065
		1	90SR	1.2	1.2	1.2
GOLDFIELD, NV, FRAYNE RANCH	10	1	3H	180	180	180
HIKO, NV, JAY WRIGHT RANCH	13	1	3H	290	290	290
		1	89SR	0.34	0.34	0.34
		1	90SR	0.22	0.22	0.22
LAS VEGAS, NV, LDS DAIRY FARMS	12	6	3H	510	91	260
		5	89SR	0.74	-0.59	0.15
		5	90SR	1.1	-0.021	0.46
LATHROP WELLS, NV, JOHN DEER RANCH	10	2	3H	240	220	230
		1	89SR	-1.7	-1.7	-1.7
		1	90SR	1.5	1.5	1.5

TABLE E-8. Continued

SAMPLING LOCATION	SAMPLE TYPE	NO. OF SAMPLES	RADIO-NUCLIDE	RADIOACTIVITY CONC. (PCI/L) MAX	MIN	AVG
LOGANDALE, NV,	12	5	3H	520	130	250
KNUDSEN DAIRY		3	89SR	0.36	-9.6	-3.3
		3	90SR	2.7	0.15	1.1
LUND, NV,	12	6	3H	400	200	300
MCKENZIE DAIRY		4	89SR	1.6	-3.7	-1.5
		4	90SR	2.3	-0.39	1.1
MCGILL, NV,	13	6	3H	520	47	310
LARSEN RANCH		6	89SR	5.7	-2.0	0.89
		6	90SR	2.3	6.5E-04	0.97
MESQUITE, NV,	12	5	3H	320	120	220
SF AND K DAIRY		3	89SR	0.44	-4.6	-1.5
		3	90SR	1.7	0.12	0.72
MOAPA, NV,	12	5	3H	500	80	330
ROCKVIEW DAIRIES, INC		4	89SR	3.0	-1.8	0.33
		4	90SR	1.4	-0.076	0.37
NYALA, NV,	13	4	3H	260	140	200
SHARP'S RANCH		3	89SR	4.5	-0.43	1.4
		3	90SR	1.5	0.022	0.98
CALIENTE, NV,	13	3	3H	390	98	210
JUNE COX RANCH		4	89SR	2.0	-0.44	0.74
		4	90SR	1.4	0.18	0.69
ROUND MT, NV,	13	4	3H	440	160	300
BERG'S RANCH		3	89SR	4.4	-10	-0.62
		3	90SR	3.5	-1.4	0.50
SHOSHONE, NV,	13	2	3H	390	310	350
HARBECKE RANCH		1	89SR	3.4	3.4	3.4
		1	90SR	3.1	3.1	3.1
CEDAR CITY, UT,	12	7	3H	530	130	270
WESTERN GEN DAIRIES		5	89SR	9.9	-1.8	1.6
		6	90SR	2.2	-4.0	-0.075
ST GEORGE, UT,	12	5	3H	450	87	290
GENTRY DAIRY		4	89SR	5.1	-0.90	1.2
		4	90SR	0.61	-2.3	0.41

TABLE E-9. ANALYTICAL RESULTS FOR THE STANDBY MILK SURVEILLANCE NETWORK - 1985

SAMPLING LOCATION	COLLECTION DATE 1985	CONC. ± 2 SIGMA 3H (PCI/L)	89SR (PCI/L)	90SR (PCI/L)
GAMMA SPECTROMETRY AND STRONTIUM ANALYSES				
LITTLE ROCK AR BORDENS	07/15	350 ± 270*	-2.4 ± 7.1*	4.4 ± 2.5
GRAND JCT CO COLORADO WEST DAIRIES	06/18	410 ± 230	-3.8 ± 9.3*	1.4 ± 1.9*
PUEBLO CO HYDE PARK DAIRY CO	06/20	410 ± 240	4.6 ± 2.1*	1.8 ± 1.1
DAVENPORT IA SWISS VALLEY FARMS CO	06/03	230 ± 270*	13 ± 10*	1.7 ± 1.1*
GARDEN CITY KS MYERS MILK PROD	06/03	190 ± 270*	-0.41 ± 11*	1.7 ± 1.3*
MANHATTAN KS KANSAS STATE UNIVERSITY	06/03	160 ± 260*	7.3 ± 6.7*	1.7 ± 0.9
BATON ROUGE LA LA STATE UNIV	07/18	200 ± 270*	3.9 ± 11*	0.49 ± 4.3*
MONROE LA BORDEN'S	07/22	69 ± 280*	-4.0 ± 2.8*	3.4 ± 1.2
FOSSTON MN LAND O' LAKES INC	05/29	330 ± 260*	-0.54 ± 1.2*	3.5 ± 1.2
ROCHESTER MN ASSOC. MILK PRODUCERS	07/05	286 ± 254*	1.4 ± 4.15*	2.0 ± 1.54*
AURORA MO MID-AMERICA DAIRY INC	06/05	380 ± 270*	-2.8 ± 2.9*	3.4 ± 1.4
CHILLICOTHE MO MID-AMERICA DAIRYMEN	06/06	390 ± 240	1.2 ± 9.6*	1.6 ± 2.1*
NORFOLK NE GILLETTE DAIRY	06/06	360 ± 270*	5.7 ± 16*	2.1 ± 1.5

(continued)

TABLE E-9. Continued

SAMPLING LOCATION	COLLECTION DATE 1985	CONC. ± 2 SIGMA		
		3H (PCI/L)	89SR (PCI/L)	90SR (PCI/L)
NO PLATTE NE				
MID-AMER DAIRYMEN-R A N	06/04	370 ± 270*	6.1 ± 18*	4.1 ± 1.6
ALBUQUERQUE NM				
BORDEN VALLEY GOLD	07/12	210 ± 280*	0.81 ± 3.1*	1.4 ± 1.3*
LA PLATA NM				
ROTHLISBERGER DAIRY	07/13	340 ± 270*	3.4 ± 3.4*	0.40 ± 1.4*
GRAND FORKS ND				
MINNESOTA DAIRY	06/17	230 ± 270*	-4.6 ± 3.7*	2.2 ± 1.5
ENID OK				
AMPI GOLDSPOT DIVISION	07/15	380 ± 230	4.1 ± 6.5*	2.2 ± 2.4*
MCALESTER OK				
OK STATE PENITENTIARY	07/16	310 ± 270*	4.2 ± 9.7*	0.16 ± 3.5*
PROVO UT				
BYU DAIRY PRODUCTS LAB	06/19	210 ± 270*	-1.1 ± 2.3*	1.2 ± 1.0

(continued)

TABLE E-9. Continued

SAMPLING LOCATION	COLLECTION DATE 1984	SAMPLING LOCATION	COLLECTION DATE 1984
GAMMA SPECTRAL ANNALYSES ONLY**			
PIMA AZ		OXNARD CA	
SMITH HUNT DAIRY	08/06	CHASE BROS DAIRY	08/05
TAYLOR AZ		REDDING CA	
SUNRISE DAIRY	08/12	MCCOLL'S DAIRY PROD	08/07
TEMPE AZ		SAN LUIS OBISPO CA	
UNITED DAIRYMEN OF AZ	08/06	CAL STATE POLY	08/06
TUCSON AZ		SEBASTOPOL CA	
SHAMROCK DAIRY (PIMA CO)	08/08	WM MILLER DAIRY	08/05
YUMA AZ		SMITH RIVER CA	
GOLDEN WEST DAIRY	08/07	COUNTRY MAID DAIRY	08/06
FAYETTEVILLE AR		SOLEDAD CA	
UNIVERSITY OF ARK	07/15	CTF DAIRY	08/05
PARAGOULD AR		TRACY CA	
FOREMOST FOODS INC	07/16	DEUEL VOC INST	08/19
RUSSELLVILLE AR		WEED CA	
ARKANSAS TECH UNIV	07/17	MEDO-BEL CREAMERY	08/13
BAKERSFIELD CA		WILLITS CA	
CARNATION DAIRY	08/05	RIDGEWOOD RANCH DAIRY	08/08
CHINO CA		WILLOWS CA	
CALIF INST FOR MEN	08/05	FOREMOST FOODS COMPANY	08/15
FERNBRIDGE CA		COLORADO SPGS CO	
HUMBOLDT CREAMERY	08/06	SINTON DAIRY CO	06/20
FRESNO CA		DELTA CO	
STATE UNIV CREAMERY	08/12	ARDEN MEADOW GOLD DAIRY	06/23
MANTECA CA		FT COLLINS CO	
DEJAGER DAIRY 2 NORTH	08/07	POUDRE VALLEY DAIRY	06/20
MODESTO CA		BOISE ID	
FOSTER FARMS DAIRY	08/07	MEADOW GOLD DAIRIES	08/26

(continued)

TABLE E-9. Continued

SAMPLING LOCATION	COLLECTION DATE 1984	SAMPLING LOCATION	COLLECTION DATE 1984
GAMMA SPECTRAL ANNALYSES ONLY**			
TWIN FALLS ID YOUNGS DAIRY	08/26	FLENSBURG MN FLENSBURG CO-OP CMRY	05/29
CALDWELL ID DCA RECEIVING STA	08/28	NICOLLET MN WALTER SCHULTZ FARM	05/31
IDAHO FALLS ID WESTERN GENERAL DAIRY	08/26	JACKSON MO MID-AMERICA DAIRYMEN IN	06/10
LEWISTON ID GOLDEN GRAIN DAIRY PROD	08/26	JEFFERSON CITY MO CENTRAL DAIRY CO	06/03
POCATELLO ID ROWLAND'S DAIRY	08/26	BILLINGS MT MEADOW GOLD DAIRY	06/17
KIMBALLTON IA AMPI RECEIVING STA	06/04	GREAT FALLS MT MEADOW GOLD DAIRY	06/17
LAKE MILLS IA LAKE MILLS COOP CRMY	06/04	MISSOULA MT BEATRICE DAIRY PRODUCTS	06/18 06/20
LEMARS IA WELLS DAIRY	06/03	GERING NE 4-STATES DAIRY-D SCHILL	06/04
ELLIS KS MID-AMERICA DAIRY	06/04	GD ISLAND NE MID-AMER DAIRYMN-JIM SA	06/04
HAMMOND LA SOUTHEASTERN LA COLLEGE	07/23	OMAHA NE ROBERTS DAIRY-MARSHALL	06/04
LAFAYETTE LA UNIV SOUTHWESTERN LA	07/19	SUPERIOR NE MID-AMER DAIRYMN-D FRIT	06/04
LAKE CHARLES LA BORDEN'S	07/24	FALLON NV CREAMLAND DAIRY	08/06
SHREVEPORT LA MIDWEST FARMS	07/22	DEVILS LAKE ND LAKE VIEW DAIRY	06/20
DALTON MN DALTON CO-OP CREAMERY	05/31	FARGO ND CASSCLAY CREAMERY	06/13

(continued)

TABLE E-9. Continued

SAMPLING LOCATION	COLLECTION DATE 1985	SAMPLING LOCATION	COLLECTION DATE 1985
GAMMA SPECTRAL ANNALYSES ONLY**			
JAMESTOWN ND COUNTRY BOY DAIRY	06/17	SIOUX FALLS SD TERRACE PARK DAIRY	06/17
WILLISTON ND PETERSONS CREAMERY	06/17	VOLGA SD LAND O'LAKES INC	06/19
CLAREMORE OK SWAN BROS DAIRY	07/15	RICHFIELD UT IDEAL DAIRY	06/20
STILLWATER OK OSU DAIRY	07/15	MOSES LAKE WA SAFEWAY STORES INC	08/26
CORVALLIS OR SUNNY BROOK DAIRY	08/27	SEATTLE WA CONSOLIDATED DAIRY PROD	08/26
MEDFORD OR DAIRYGOLD FARMS	08/27	SPOKANE WA CONSOLIDATED DAIRY	08/26
TILLAMOOK OR TILLAMOOK CO CRMY	08/26	CHEYENNE WY DAIRY GOLD FOODS	06/18
MITCHELL SD CULHANES DAIRY	06/17	POWELL WY CREAM OF THE VALLEY DAI	06/22
RAPID CITY SD BROWN SWISS DAIRY	06/18	RIVERTON WY ALBERTSON'S PLANT	06/17

* CONCENTRATION IS LESS THAN THE MINIMUM DETECTABLE CONCENTRATION (MDC).

** POTASSIUM-40 WAS THE ONLY GAMMA-EMITTER DETECTED.

TABLE E-10. SUMMARY OF RADIATION DOSE EQUIVALENTS FROM TLD DATA - 1985

STATION LOCATION	MEASUREMENT PERIOD		DOSE EQUIVALENT RATE (MREM/D)			ADJUSTED DOSE EQUIVALENT
	ISSUE	COLLECT	MAX.	MIN.	AVG.	(MREM/Y)
ADAVEN, NV	01/09/85	12/10/85	0.31	0.27	0.30	110
ALAMO, NV	01/09/85	11/07/85	0.25	0.21	0.23	84
AMERICAN BORATE, NV	01/10/85	11/07/85	0.28	0.27	0.28	102
ATLANTA MINE, NV	01/16/85	12/09/85	0.24	0.20	0.21	77
AUSTIN, NV	01/17/85	01/08/86	0.33	0.30	0.31	113
BAKER, CA	01/07/85	12/13/85	0.23	0.20	0.22	80
BARSTOW, CA	01/07/85	12/12/85	0.28	0.24	0.26	95
BATTLE MOUNTAIN, NV	01/08/85	12/11/85	0.23	0.20	0.21	77
BEATTY, NV	01/07/85	11/07/85	0.32	0.27	0.29	106
BISHOP, CA	01/08/85	12/11/85	0.27	0.24	0.26	95
BLUE EAGLE RANCH, NV	01/08/85	12/10/85	0.19	0.16	0.17	62
BLUE JAY, NV	01/15/85	01/15/86	0.35	0.29	0.32	117
BOULDER, UT	01/15/85	12/10/85	0.24	0.21	0.23	84
BRYCE CANYON, UT	01/15/85	12/10/85	0.23	0.19	0.22	80
CACTUS SPRINGS, NV	01/07/85	11/04/85	0.18	0.15	0.17	62
CALIENTE, NV	01/10/85	11/06/85	0.29	0.23	0.27	99
CARP, NV	01/10/85	11/06/85	0.29	0.25	0.27	99
CASEY'S RANCH, NV	01/15/85	01/15/86	0.22	0.18	0.20	73
CEDAR CITY, UT	01/08/85	11/05/85	0.20	0.15	0.18	66
CHERRY CREEK, NV	01/10/85	12/10/85	0.30	0.24	0.26	95
CLARK STATION, NV	01/16/85	01/13/86	0.31	0.27	0.29	106
COALDALE, NV	01/16/85	12/11/85	0.28	0.24	0.25	91
COLORADO CITY, AZ	01/15/85	11/05/85	0.25	0.18	0.19	69
COMPLEX 1, NV	01/09/85	12/10/85	0.31	0.28	0.30	110
CORN CREEK, NV	01/07/85	11/08/85	0.15	0.10	0.13	47
CORTEZ RD/HWY 278, NV	01/09/85	12/11/85	0.31	0.24	0.27	99
COYOTE SUMMIT, NV	01/15/85	01/13/86	0.34	0.28	0.31	113
CRESCENT VALLEY, NV	01/08/85	12/11/85	0.24	0.21	0.22	80
CRYSTAL, NV	01/07/85	11/08/85	0.22	0.19	0.20	73
CURRANT, NV	01/08/85	12/11/85	0.28	0.23	0.26	95
CURRIE, NV	01/09/85	12/10/85	0.28	0.23	0.25	91
DEATH VALLEY JCT, CA	01/10/85	11/07/85	0.21	0.16	0.19	69
DELTA, UT	01/22/85	01/13/86	0.22	0.17	0.20	73
DIABLO MAINT. STA., NV	01/16/85	01/13/86	0.38	0.30	0.35	128
DUCHESNE, UT	01/23/85	01/15/86	0.22	0.18	0.19	69
DUCKWATER, NV	01/08/85	12/11/85	0.26	0.22	0.24	88
ELGIN, NV	01/10/85	11/06/85	0.33	0.29	0.31	113
ELKO, NV	01/09/85	12/10/85	0.30	0.20	0.24	88
ELY, NV	01/08/85	12/11/85	0.24	0.19	0.21	77
ENTERPRISE, UT	01/09/85	11/05/85	0.33	0.25	0.30	110
EUREKA, NV	01/17/85	01/07/86	0.27	0.26	0.27	99
FALLON, NV	01/07/85	12/11/85	0.21	0.19	0.20	73
FERRON, UT	01/24/85	11/06/85	0.20	0.17	0.19	69

(continued)

TABLE E-10. Continued

STATION LOCATION	MEASUREMENT PERIOD		DOSE EQUIVALENT RATE (MREM/D)			ADJUSTED DOSE EQUIVALENT
	ISSUE	COLLECT	MAX.	MIN.	AVG.	(MREM/Y)
FLYING DIAMOND, CP, NV	01/08/85	12/12/85	0.21	0.17	0.20	73
FURNACE CREEK, CA	01/10/85	11/06/85	0.17	0.14	0.16	58
GABBS, NV	01/16/85	12/11/85	0.21	0.17	0.18	66
GARRISON, UT	01/07/85	12/09/85	0.21	0.17	0.19	69
GEYSER RANCH, NV	01/07/85	12/09/85	0.27	0.23	0.25	91
GOLDFIELD, NV	01/15/85	01/06/86	0.24	0.21	0.22	80
GRANTSVILLE, UT	01/23/85	01/14/86	0.22	0.19	0.20	73
GREEN RIVER, UT	01/23/85	11/05/85	0.20	0.17	0.18	66
GROOM LAKE-NTS, NV	01/15/85	01/07/86	0.22	0.17	0.19	69
GUNNISON, UT	01/21/85	11/06/85	0.19	0.16	0.18	66
HANCOCK SUMMIT, NV	01/15/85	01/13/86	0.42	0.36	0.39	142
HIKO, NV	01/09/85	11/07/85	0.20	0.16	0.19	69
HOT CK RNCH, NV	01/21/85	01/15/86	0.27	0.21	0.24	88
IBAPAH, UT	01/22/85	12/09/85	0.29	0.24	0.27	99
INDEPENDENCE, CA	01/08/85	12/11/85	0.25	0.22	0.24	88
INDIAN SPRINGS, NV	01/07/85	11/04/85	0.17	0.13	0.15	55
JACOB'S LAKE, AZ	01/15/85	11/04/85	0.28	0.26	0.27	99
KANAB, UT	01/15/85	11/04/85	0.19	0.16	0.17	62
KIRKEBY RANCH, NV	01/07/85	12/09/85	0.22	0.18	0.20	73
KOYENS RANCH, NV	01/15/85	01/15/86	0.26	0.22	0.24	88
LAS VEGAS, NV (AIRPT)	01/02/85	12/31/85	0.15	0.12	0.14	51
LAS VEGAS, NV (PLACAK)	01/02/85	12/31/85	0.16	0.12	0.14	51
LAS VEGAS, NV (UNLV)	01/02/85	12/31/85	0.13	0.10	0.11	40
LAS VEGAS, NV (USDI)	01/02/85	12/31/85	0.18	0.14	0.16	58
LATHROP WELLS, NV	01/07/85	11/04/85	0.25	0.24	0.25	91
LAVADA'S MARKET, NV	01/09/85	11/08/85	0.23	0.22	0.22	80
LIDA, NV	01/15/85	01/07/86	0.30	0.23	0.27	99
LOA, UT	01/16/85	12/10/85	0.35	0.33	0.33	120
LOGAN, UT	01/24/85	01/06/86	0.17	0.13	0.15	55
LONE PINE, CA	01/08/85	12/11/85	0.24	0.22	0.23	84
LOVELOCK, NV	01/08/85	12/11/85	0.20	0.19	0.19	69
LUND, NV	01/10/85	12/10/85	0.23	0.20	0.22	80
LUND, UT	01/17/85	12/11/85	0.30	0.28	0.29	106
MAMMOTH MOUNTAIN, CA	01/09/85	12/11/85	0.33	0.22	0.28	102
MANHATTAN, NV	01/17/85	01/08/86	0.35	0.29	0.32	117
MESQUITE, NV	01/07/85	11/04/85	0.16	0.12	0.15	55
MILFORD, UT	01/16/85	12/09/85	0.26	0.23	0.24	88
MINA, NV	01/16/85	12/11/85	0.29	0.23	0.25	91
MOAPA, NV	01/07/85	11/04/85	0.18	0.15	0.16	58
MONTICELLO, UT	01/16/85	11/05/85	0.26	0.22	0.24	88
NASH RANCH, NV	01/15/85	12/12/85	0.22	0.17	0.21	77
NEPHI, UT	01/22/85	01/13/86	0.20	0.17	0.18	66
NYALA, NV	01/16/85	01/15/86	0.24	0.19	0.22	80

(continued)

TABLE E-10. Continued

STATION LOCATION	MEASUREMENT PERIOD ISSUE	MEASUREMENT PERIOD COLLECT	DOSE EQUIVALENT RATE (MREM/D) MAX.	MIN.	AVG.	ADJUSTED DOSE EQUIVALENT (MREM/Y)
OLANCHA, CA	01/08/85	12/12/85	0.25	0.22	0.23	84
OVERTON, NV	01/07/85	11/04/85	0.15	0.11	0.13	47
PAGE, AZ	01/16/85	11/05/85	0.18	0.15	0.16	58
PAHRUMP, NV	01/07/85	11/07/85	0.16	0.13	0.14	51
PAROWAN, UT	01/17/85	12/10/85	0.22	0.21	0.21	77
PENOYER FARMS, NV	01/16/85	01/13/86	0.34	0.27	0.30	110
PINE CREEK RANCH, NV	01/10/85	12/10/85	0.32	0.30	0.31	113
PIOCHE, NV	01/09/85	12/09/85	0.22	0.15	0.21	77
PRICE, UT	01/23/85	01/16/86	0.22	0.18	0.20	73
PROVO, UT	01/22/85	01/14/86	0.22	0.19	0.20	73
QUEEN CITY SMT, NV	01/15/85	01/13/86	0.38	0.30	0.35	128
RACHEL, NV	01/15/85	01/15/86	0.32	0.26	0.29	106
REED RANCH, NV	01/15/85	01/13/86	0.33	0.26	0.30	110
RIDGECREST, CA	01/07/85	12/12/85	0.22	0.20	0.21	77
ROSE RANCH, NV	01/16/85	12/09/85	0.30	0.17	0.26	95
ROUND MT, NV	01/17/85	01/08/86	0.30	0.28	0.30	110
RUBY VALLEY, NV	01/10/85	12/10/85	0.32	0.23	0.27	99
S.DESERT COR CENTR, NV	01/07/85	11/08/85	0.15	0.13	0.14	51
SALT LAKE CITY, UT	01/04/85	11/08/85	0.33	0.20	0.23	84
SCHURZ, NV	01/07/85	12/11/85	0.28	0.24	0.25	91
SCOTTY'S JCT, NV	01/15/85	01/06/86	0.30	0.26	0.27	99
SHERI'S RANCH, NV	01/11/85	11/07/85	0.25	0.21	0.23	84
SHOSHONE, CA	01/11/85	11/07/85	0.20	0.16	0.19	69
SPRINGDALE, NV	01/08/85	11/06/85	0.33	0.29	0.31	113
ST. GEORGE, UT	01/07/85	11/05/85	0.15	0.11	0.13	47
STONE CABIN RNCH, NV	01/15/85	01/14/86	0.33	0.25	0.29	106
SUNNYSIDE, NV	01/09/85	12/12/85	0.18	0.14	0.15	55
TEMPIUTE, NV	01/15/85	01/15/86	0.33	0.27	0.30	110
TIKABOO VALLEY, NV	01/15/85	01/13/86	0.33	0.26	0.29	106
TONOPAH TEST RNG, NV	01/16/85	01/07/86	0.35	0.25	0.28	102
TONOPAH, NV	01/15/85	01/07/86	0.33	0.28	0.30	110
TROUT CREEK, UT	01/22/85	12/09/85	0.22	0.19	0.20	73
TWIN SPRGS RNCH, NV	01/16/85	01/14/86	0.33	0.27	0.30	110
US ECOLOGY, NV	01/07/85	11/07/85	0.34	0.29	0.30	110
VALLEY CREST, CA	01/10/85	11/07/85	0.17	0.12	0.16	58
VERNAL, UT	01/23/85	01/15/86	0.26	0.23	0.24	88
VERNON, UT	01/23/85	01/14/86	0.23	0.20	0.21	77
WARM SPRINGS, NV	01/16/85	01/13/86	0.38	0.30	0.34	124
WELLS, NV	01/09/85	12/10/85	0.29	0.22	0.25	91
WENDOVER, UT	01/09/85	12/09/85	0.20	0.17	0.18	66
WILLOW SPR LDGE, UT	01/23/85	01/14/86	0.19	0.17	0.18	66
WINNEMUCCA, NV	01/08/85	12/11/85	0.23	0.20	0.21	77
YOUNG'S RANCH, NV	01/17/85	01/08/86	0.24	0.22	0.23	84

TABLE E-11. SUMMARY OF RADIATION DOSES FOR OFF-SITE RESIDENTS - 1985

RES-I-DENT NO.	BACKGROUND STATION LOCATION	MEASUREMENT PERIOD		DOSE EQUIVALENT RATE (MREM/D)			NET EXPOSURE
		ISSUE	COLLECT	MAX.	MIN.	AVG.	(MREM)
2	CALIENTE, NV	01/10/85	01/08/86	0.31	0.30	0.30	1.2
6	INDIAN SPRINGS, NV	01/08/85	01/17/86	0.15	0.13	0.14	0.0
7	GOLDFIELD, NV	01/15/85	01/06/86	0.24	0.21	0.22	0.0
8	TWIN SPRINGS RANCH, NV	01/16/85	01/14/86	0.29	0.25	0.27	0.0
9	BLUE EAGLE RANCH, NV	01/08/85	01/07/86	0.19	0.16	0.18	0.0
10	COYOTE SUMMIT, NV	01/09/85	01/08/86	0.29	0.27	0.28	0.0
11	COYOTE SUMMIT, NV	01/09/85	01/08/86	0.30	0.26	0.28	0.0
13	KOYENS RANCH, NV	01/15/85	01/15/86	0.24	0.17	0.20	0.0
14	TIKABOO VALLEY, NV	01/15/85	01/13/86	0.26	0.22	0.24	0.0
15	TIKABOO VALLEY, NV	01/15/85	01/13/86	0.26	0.23	0.24	0.0
18	NYALA, NV	01/16/85	01/15/86	0.20	0.19	0.20	0.0
19	GOLDFIELD, NV	01/15/85	01/06/86	0.21	0.19	0.20	0.0
21	BEATTY, NV	01/08/85	01/16/86	0.25	0.22	0.24	0.0
22	ALAMO, NV	01/09/85	01/08/86	0.20	0.17	0.18	0.0
24	LAS VEGAS, NV (USDI)	01/04/85	12/31/85	0.15	0.12	0.13	0.0
25	CORN CREEK, NV	01/02/85	12/31/85	0.16	0.14	0.15	11.8
28	HOT CREEK RANCH, NV	01/15/85	11/06/85	0.28	0.24	0.26	0.0
29	STONE CABIN RANCH, NV	01/15/85	01/14/86	0.30	0.25	0.27	0.0
30	RACHEL, NV	01/21/85	08/05/85	0.33	0.23	0.26	0.0
33	LATHROP WELLS, NV	01/09/85	01/15/86	0.25	0.22	0.23	0.0
34	FURNACE CREEK, CA	01/10/85	01/14/86	0.16	0.12	0.15	0.0
35	DEATH VALLEY JCT., CA	01/10/85	07/01/85	0.19	0.18	0.19	0.0

(continued)

TABLE E-11. Continued

RES-I-DENT NO.	BACKGROUND STATION LOCATION	MEASUREMENT PERIOD		DOSE EQUIVALENT RATE (MREM/D)			NET EXPOSURE
		ISSUE	COLLECT	MAX.	MIN.	AVG.	(MREM)
36	PAHRUMP, NV	01/08/85	01/15/86	0.16	0.11	0.13	0.0
37	INDIAN SPRINGS, NV	01/10/85	01/17/86	0.18	0.11	0.15	4.0
38	BEATTY, NV	01/08/85	01/16/86	0.35	0.27	0.31	0.0
40	GOLDFIELD, NV	01/15/85	01/06/86	0.22	0.21	0.21	0.0
42	TONOPAH, NV	01/15/85	01/07/86	0.26	0.23	0.24	0.0
44	CEDAR CITY, UT	01/08/85	01/07/86	0.22	0.20	0.22	0.0
45	ST. GEORGE, UT	01/07/85	01/06/86	0.24	0.18	0.20	8.0
47	ELY, NV	01/08/85	01/07/86	0.25	0.23	0.24	0.0
49	LAS VEGAS, NV (UNLV)	01/02/85	12/31/85	0.20	0.18	0.19	27.7
50	HOT CREEK RANCH, NV	01/15/85	11/06/85	0.28	0.24	0.26	0.0
51	TONOPAH, NV	01/16/85	01/08/86	0.29	0.23	0.26	0.0
52	SALT LAKE CITY, UT	01/04/85	01/03/86	0.70	0.32	0.45	70.9
54	RACHEL, NV	01/15/85	01/15/86	0.30	0.24	0.27	0.0
55	RACHEL, NV	01/21/85	01/15/86	0.27	0.24	0.25	0.0
56	CORN CREEK STATION, NV	01/02/85	12/31/85	0.18	0.12	0.15	9.3
57	OVERTON, NV	01/07/85	01/06/86	0.20	0.19	0.15	15.3
59	CEDAR CITY, UT	01/08/85	04/09/85	0.19	0.19	0.19	0.0
60	SHOSHONE, CA	01/18/85	01/14/86	0.21	0.16	0.18	0.0
223	LAS VEGAS, NV (USDI)	01/02/85	12/31/85	0.14	0.10	0.12	0.0
232	HIKO, NV	01/09/85	01/08/86	0.24	0.21	0.23	9.9
233	ELY, NV	01/08/85	01/06/86	0.21	0.20	0.21	0.0
235	CALIENTE, NV	01/10/85	06/06/85	0.24	0.23	0.23	0.0

(continued)

TABLE E-11. Continued

RES-I-DENT NO.	BACKGROUND STATION LOCATION	MEASUREMENT PERIOD ISSUE	COLLECT	DOSE EQUIVALENT RATE (MREM/D) MAX.	MIN.	AVG.	NET EXPOSURE (MREM)
239	TONOPAH, NV	01/16/85	01/15/86	0.34	0.26	0.29	0.0
247	CALIENTE, NV	01/10/85	01/08/86	0.20	0.17	0.19	0.0
248	PENOYER FARMS, NV	01/16/85	01/13/86	0.25	0.23	0.24	0.0
249	AUSTIN, NV	01/17/85	01/08/86	0.28	0.21	0.24	0.0
258	PIOCHE, NV	05/07/85	01/06/86	0.26	0.24	0.24	0.0
262	CORN CREEK, NV	07/01/85	12/02/85	0.16	0.13	0.15	0.0
263	DEATH VALLEY JCT, CA	07/01/85	01/14/86	0.17	0.17	0.17	0.0
264	RACHEL, NV	08/05/85	01/15/86	0.31	0.26	0.29	0.0

APPENDIX E

DATA SUMMARY FOR THE MONITORING NETWORKS

ADDENDUM 1

NONRADIOLOGICAL SUPPLEMENT TO THE NTS ENVIRONMENTAL MONITORING REPORT

Prepared by:

Industrial Hygiene
Reynolds Electrical and Engineering Co., Inc.

Report Period: Calendar Year, 1985

INTRODUCTION

Environmental compliance activities which are the subject of this report are regulated under Chapter 445 of the State of Nevada Administrative Codes. Chapters 445.131, 445.361, and 445.401 respectively address water pollution control, public water systems, and air pollution. There were a total of 21 facilities which had State of Nevada operating permits or approval in 1985. For common information including site description, geology, land use, etc., reference the EPA Annual Report.

SUMMARY

Water Pollution

No effluent monitoring is required.

Air Pollution

There was one Notice of Violation of the 18 State air pollution operating permits. This violation was issued March 26, 1986 on the basis of State inspections made at the NTS November 5 and 6, 1985. Details of the violation are given below under the evaluation of the permits.

No effluent monitoring is required and none was performed. The allowable emissions are established by State-determined operating constraints which were not exceeded.

Ground-water Monitoring

Composite quarterly samples were taken from two wells to monitor changes in nitrate concentration.

MONITORING DATA COLLECTION, ANALYSIS, AND EVALUATION

Air Pollution Control

a. Area 1 Shaker Plant--

Operating restrictions to Permits 922 and 923 were not violated during this period. The facilities were not operated in excess of the allowable hours and an annual production report as transmitted to the State on March 24, 1986.

b. Area 12 Concrete Batch Plant--

The plant did not exceed the permit restriction of 8 hours per day, nor more than 296 hours per year. An annual report was transmitted to the State on March 24, 1986.

c. Area 3 Aggregate Plant--

The restrictions to Operating Permit 919 were not exceeded. The plant did not operate in excess of 8 hours per day, nor more than 280 hours per year. An annual production report was submitted to the State on March 24, 1986.

d. Area 5 Aggregate Plant--

The restrictions to Operating Permit 920 were not exceeded. The plant did not operate in excess of 8 hours per day, nor more than 650 hours per year. An annual production report was be submitted by March 24, 1986.

This Aggregate Plant was relocated in Area 1 and the crusher was replaced without notifying the State. These two items were part of the violation issued March 26, 1986. A permit application for the new Aggregate Plant to operate in Area 1 was sent to the State on April 4, 1986 to correct the situation.

e. Area 5 Surface Area Disturbance--

The restrictions to Permit 921 were not exceeded. A final fugitive dust control plan will be submitted at least six months prior to abandonment of the site.

f. Area 2 Stemming Systems--

The restrictions to Operating Permits 957 and 958 were not exceeded.

g. NTS 4,000,000 BTU/hour or Greater Boiler Permits--

The restrictions to Permits 1035, 1036 and 925 were not exceeded. The boilers were not operated in excess of 8,400 hours per year. All boilers used Number 2 fuel oil. An annual analysis of fuel for sulfur and BTU content was submitted on September 17, 1986.

h. Two fuel storage tanks in Area 6 and two in Area 23 were in use at the time of the State inspections and were included in the violation. Operating Permits have been received for these four tanks since the inspection, as noted on the violation report.

Ground-Water Monitoring

Monthly ground-water samples were collected from Wells Ue5C and Ue5B and composited into calendar year quarterly samples to monitor changes in nitrate concentration. The last sample analyzed from Well Ue5B was 31.0 milligrams of nitrates per liter (mg/l) and the sample from Well Ue5C was 21.7 mg/l.

ADDENDUM 2
PART A

ENVIRONMENTAL PERMITS, ORDERS, AND NOTICES

Part A of this Addendum pertains to EG&G activities at the locations shown. Air Quality permits are subject to yearly renewal. The North Las Vegas Waste Water permit expires August 9, 1987, while Clark County is being issued and will expire April 1, 1988. The hazardous waste permits have no expiration dates, while the Santa Barbara Industrial Waste permit is renewed annually. All EG&G activities are in compliance with existing Federal, State, and County regulations.

EG&G Operations	Permit/Notification Type	Issue Date	Issuing Agency
Santa Barbara Operation	Notification of Hazardous Waste Activity EPA ID #CAD980813224	Feb. 1985	State of California
	Extremely Hazardous Waste Disposal Permit #3-6757	April 1985	State of California
	Industrial Waste Control Permit #II-202	1973	Goleta Sanitary Dist. California
Kirtland Oper. (Craddock Fac.)	Notification of Hazardous Waste Activity EPA ID #NMD049986896	Dec. 1985	State of New Mexico
Los Alamos	No Notifications or Permits required	----	----
Washington Aerial Measurements	No Notifications or Permits required	----	----
San Ramon Oper.	Notification of Hazardous Waste Activity EPA ID #CAD056196900	May 1983	State of California
	Waste Water Discharge Permit #3672-101	Nov. 1985(1)	Dublin/San Ramon Sanitary Dist. California
	Waste Water Discharge Permit (no number)	Jan. 1985(2)	Central Contra Costa Sanitary Dist. California
Woburn Oper.	Notification of Hazardous Waste Activity EPA ID #MAD980578983	Jan. 1982	State of Massachusetts
	Waste Water Permit #43005732-0	Oct. 1984(3)	State of Massachusetts

(1) Expires September 1987.
(2) Operating with expired permit with CCCSD permission pending permit review.
(3) Expired October 31, 1985, applied for permit renewal.

ADDENDUM 2
PART A (Continued)

EG&G Operations	Permit/Notification Type	Issue Date	Issuing Agency
Las Vegas Oper.	Notification of Hazardous Waste Activity EPA ID #NVD097868731	Aug. 1980	State of Nevada
	PCB Notification NVT-PCB-137	Feb. 1986	State of Nevada
	Extremely Hazardous Waste Disposal Permit #3-8520	Jan. 1986	State of California
	Waste Water Contribution Permit #85-1	Aug. 1985	City of North Las Vegas
	Industrial Waste Water Permit	April 1988	Clark County
	Air Pollution Control Operation		Clark County
	Permits		
	A06501	Nov. 1981	Clark County
	A06502	Nov. 1981	Clark County
	A06504	Aug. 1976	Clark County
	A06505	Oct. 1976	Clark County
	A06503	Nov. 1981	Clark County
	A06506	May 1984	Clark County
	A06507	May 1984	Clark County
	A06509	May 1984	Clark County
	A06510	May 1984	Clark County
	A06511	May 1984	Clark County
	A06512	Feb. 1985	Clark County
	A06503	May 1984	Clark County
	A06504	May 1984	Clark County

ADDENDUM 2
PART B

Part B pertains to the status of the environmentally related facilities at the Nevada Test Site, administered through the Reynolds Electrical & Engineering Co., Inc. (REECo). It includes actions initiated in 1985 and pending. All REECo activities are in compliance with existing Federal, State, or County requirements.

CLEAN AIR ACT

The State of Nevada Air Quality Regulations require a registration certificate before starting construction, modification, or alterations of an air contaminant emission source. An operating permit is required before initial operation of the emission source. A registration certificate or operating permit is required before the surface disturbance of 20 acres or more accumulative total of land.

Location/Facility	Item(s)	Reason	Permit #/Issue Date		Expiration Date	Permittee
1. Area 1 Shaker Plant	Simplicity Screen Pioneer Screen Cedarapids Screen Conveyors Baghouse Bins	Process weight rate 50 pounds/ hour or more	OP922	12/3/84	12/3/89	DOE
2. Area 1 Shaker Plant	CMI Rotary Dryer Baghouse Bins	Process weight rate 50 pounds/ hour or more	OP923	12/3/84	12/3/89	DOE
3. Area 12 Concrete Batch Plant	Ideal Mfg. Co.	Process weight rate 50 pounds/ hour or more	OP928	12/3/84	12/3/89	DOE
4. Area 3 Portec Aggregate and Hopper	Bacon-Western Dust Filters	Process weight rate 50 pounds/ hour or more	OP919	12/3 84	12/3/89	DOE

ADDENDUM 2
PART B (Continued)

CLEAN AIR ACT (cont.)

Location/Facility	Item(s)	Reason	Permit #/Issue Date		Expiration Date	Permittee
5. Area 5 Aggregate Plant	Crusher Wet Screen	Process weight rate 50 pounds/ hour or more	OP920	12/3/84	12/3/89	DOE
6. Area 5 Aggregate Plant	Surface Disturbance	20 acres or more	OP921	12/3/84	12/3/89	DOE
7. Area 2 LLNL Portable Stemming System	Barber-Greene Conveyor Atlas Conveyors (2)	Process weight rate 50 pounds/ hour or more	OP957	12/3/84	12/3/89	DOE
8. Area 2 LLNL Portable Stemming System	Barber-Greene Conveyor Atlas Conveyors (2) Nordberg Conveyor	Process weight rate 50 pounds/ hour or more	OP958	12/3/84	12/3/89	DOE
9. Area 23, Bldg. 753	Ajax Boiler #83-35651	Rated capacity 4,000,000 Btu/ hour or more	OP925	12/3/84	12/3/89	DOE
10. Area 6 Decon Facility	York-Shipley Boiler Serial #82-14857	Rated capacity 4,000,000 Btu/ hour or more	OP1036	10/20/80	10/20/90	REECo
11. Portable Boiler	Superior #2 Boiler Serial #1342-1576	Rated capacity 4,000,000 Btu/ hour or more	OP1035	10/20/80	10/20/90	REECo

ADDENDUM 2
PART B (Continued)

CLEAN AIR ACT (cont.)

Location/Facility	Item(s)	Reason	Permit #/Issue Date		Expiration Date	Permittee
12. Area 6	Concrete Batch Plant	Process weight rate 50 pounds/hour or more	OP918	11/21/84	11/21/89	F&S
13. Open Burning	Fire Dept. and Env. Sci. Training	Training	86-3	9/4/85	8/23/86	REECo
14. Area 1 Shaker Plant	Surface Disturbance	20 acres or more	OP1082	1/30/86	1/30/91	REECo
15. Area 3 Portable Stemming System	4 Double Hoppers 1 Conveyor Belt	Process weight rate 50 pounds/hour or more	OP1089	2/25/86	2/25/91	REECo
16. Mercury Gasoline Tank	420,000 gallons	40,000 gallons or more	OP1086	2/25/86	2/25/91	REECo
17. Mercury Diesel Tank	420,000 gallons	40,000 gallons or more	OP1087	2/25/86	2/25/91	REECo
18. Area 6 Gasoline Tank	42,000 gallons	40,000 gallons or more	OP1090	2/25/86	2/25/91	REECo
19. Area 6 Diesel Tank	105,000 gallons	40,000 gallons or more	OP1085	2/25/86	2/25/91	REECo
20. Area 1 Concrete Batch Plant	Rex Lo-Go Plant	Process weight rate 50 pounds/hour or more	OP1082	1/30/86	1/30/91	REECo

CLEAN AIR ACT RECENT AND PENDING ACTIONS

AREA/FACILITY	STATUS
1. Area 14 Surface Disturbance Rocket Propellant Burn	Registration Certificate RC 1122 received pm 1/30/86.
2. Area 6 DAF Surface Disturbance	Application submitted by DOE/NV. Fees sent to DOE/NV, 12/20/84. (RC action waiting final design; DOE action.)
3. Area 3 Mud Plant	Application information being gathered; not yet submitted to State.
4. Area 19 & 20 Portable Mud Plant	Application information being gathered; not yet submitted to State.
5. Area 5 Burn Permit Fire Stack Test	Approved 12/11/85 to conduct using NTS Burn Permit #86-3.

WATER POLLUTION

State of Nevada Water Pollution Control Regulations require a permit for construction, installation, or significant modification of sewage collection and treatment facilities and review of plans and specifications for sewage treatment works.

The State of Nevada inspected the sewage treatment systems (lagoons) in Areas 6, 12, and 23 in November 1985. Applications for permits resulting from this inspection have been made and will be shown in next year's report.

The Area 30 Exploratory Shaft Sanitary Waste System Plan was reviewed by the State and approved 3/2/84.

CLEAN WATER

State of Nevada water supply regulations require review and approval of plans and specifications for construction of public (potable) water systems and for any substantial addition to or alteration of existing systems and periodic sampling for bacteriological, chemical, and radiological analyses.

ADDENDUM 2
PART B (Continued)

Permits received:

System	Permit No.	Expiration Date	Permittee
NTS-Area 23	NY-360-12C	9/30/86	REECo (D. M. Bullock)
NTS-Area 1	NY-5024-12NC	9/30/86	REECo/NTS
NTS-Area 2 & 12	NY-4099-12C	9/30/86	REECo/NTS
NTS-Area 6	NY-5000-12NC	9/30/86	REECo/NTS
NTS-Area 3	NY-4097-12NC	9/30/86	REECo/NTS
NTS-Area 25	NY-4098-12NC	9/30/86	REECo/NTS

Periodic sampling for bacteriological, chemical, and radiological analyses is being done.

SOLID WASTE

State of Nevada Regulations governing solid waste require review and approval of solid waste management plans.

There is a salvage yard in Area 23; sanitary landfills in Areas 6, 10, and 23; and construction landfills in Areas 3, 19, and 25. DOE/NV instructed REECo on April 4, 1985 to obtain the necessary State permits or approvals for these facilities.

RCRA WASTE

REECo has an EPA Identification Number, NV3890090001, for hazardous waste activities. A Part B permit application for the Radioactive Waste Management Site Landfill in Area 5 was submitted to EPA Region IX by DOE/NV November 1985.

PCBS

REECo has been issued PCB Generator I.D. No. NVG-PCB-006 by the State.

ADDENDUM 2
PART C

Part C pertains to the status of the environmentally related facilities at the Tonopah Test Range, administered through the REECo. All activities currently comply with Federal, State, and County requirements.

CLEAN AIR ACT

1. REECo was issued Operating Permit #1083 for the Ross Concrete Batch Plant on 1/30/86. This permit expires 1/30/91.
2. REECo was issued Operating Permit #1081 for the C. S. Johnson Batch Plant on 1/30/86. This permit expires 1/30/91.
3. A permit for open burning at the Fire Department Training Facility in the TTR was issued 3/19/86. This permit (#86-16) expires 9/17/86.
4. Permit applications for the five large Fuel Storage Tanks are near completion and should be sent to the State by 4/4/86.

WATER POLLUTION

1. The sewage lagoons are complete and in operation, replacing the 100,000 gpd Sewage Treatment Package Plant. Plans for this modification and for bypassing the 50,000 gpd Package Plant to the sewage lagoons were submitted to the State for review and approval on 9/17/85. A permit will be issued.
2. Plans for the Sewage Treatment Package Plant to be installed at Site 4 were submitted to the State for review and approval on 10/31/85. Approval is expected after State receipt of additional requested information. A permit will not be issued (less than 10,000 gpd inflow).

CLEAN WATER

1. Public Water Supply Operating Permits:

   Permits Received:

System	Permit No.	Expiration Date	Permittee
TTR-Sandia-Area 6	NY-3014-12NC	9/30/86	REECo (D. M. Bullock)
TTR-Site 3	NY-5001-12NC	9/30/86	REECo/TTR
TTR-Site O&M (Air Force Well)	NY-5002-12NC	9/30/86	REECo/TTR
TTR-Site 1A	NY-4068-12NC	9/30/86	REECo/TTR

ADDENDUM 2
PART C (Continued)

SOLID WASTE

Operation and maintenance plan for the sanitary landfill was submitted to the State on December 19, 1981.

RCRA WASTE

TTR has an EPA Identification Number, NV N3570090016, for hazardous waste activities.

ADDENDUM 2
PART D

Part D of this Addendum pertains to Fenix & Scisson, Inc. (F&S), located at the Nevada Test Site. F&S activities are in compliance with Federal, State, and County requirements.

F&S Location	Permit Type	Permit No.	Issued	Expires
NTS-All Areas (Portable Silos)	Air Quality	918	11/21/84	11/21/85*

*undergoing renewal

ADDENDUM 3

ENVIRONMENTAL IMPACT STATEMENTS AND ENVIRONMENTAL ASSESSMENTS

The following Environmental Assessments were completed in CY 1985:

1. United States Geological Survey (USGS) Drill Holes and Trenches - Yucca Mountain and Crater Flats
2. The Liquid Gas Fuel Spill Test Facility at Frenchmen Flat, Nevada Test Site

No Environmental Impact Statements were written in CY 1985.

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

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DOE/DP/00539-056

2.

3. RECIPIENT'S ACCESSION NO.

4. TITLE AND SUBTITLE
OFFSITE ENVIRONMENTAL MONITORING REPORT
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Calendar Year 1985

5. REPORT DATE

6. PERFORMING ORGANIZATION CODE

7. AUTHOR(S)
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D. J. Thome', and D. D. Smith

8. PERFORMING ORGANIZATION REPORT NO.
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9. PERFORMING ORGANIZATION NAME AND ADDRESS
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16. ABSTRACT

This report covers the routine radiation monitoring activities conducted by the Environmental Monitoring Systems Laboratory-Las Vegas in areas which may be affected by nuclear testing programs of the Department of Energy. This monitoring is conducted to document compliance with standards, to identify trends in environmental radiation, and to provide such information to the public. It summarizes activities for calendar year 1985.

No radioactivity attributable to NTS activities was detectable offsite by the monitoring networks. Using recorded wind data and Pasquill stability categories, atmospheric dispersion calculations based on reported radionuclides released yield an estimated dose of 0.0002 person-rem to the population within 80 km of the Nevada Test Site during 1985. World-wide fallout of Kr-85, Sr-90, HTO, and Pu-239 detected by the monitoring networks would cause maximum exposure to an individual of less than 0.14 mrem per year. Plutonium in air was still detectable along with krypton-85, which continued its gradual increase, as has been reported previously. Strontium in milk was near the detection limit. An occasional net exposure to offsite residents has been detected by the TLD network. On investigation, the cause of such net exposures has been due to personal habits or occupational activities, not to NTS activities.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group

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